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Volume 6 • Issue 34 • 2000

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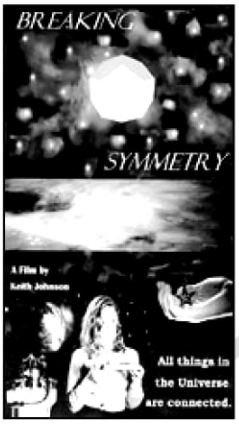

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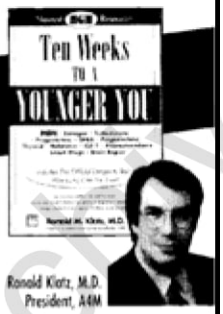

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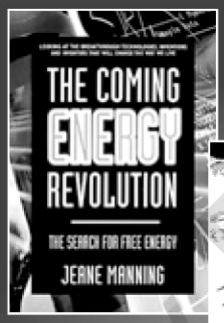
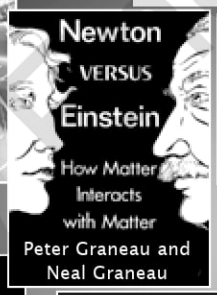
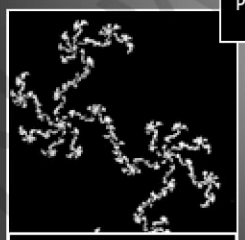
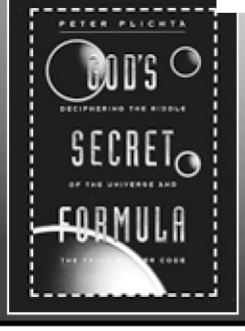






Heretical Verities
Mathematical Themes in Physical Description
Thomas E. Phipps, Jr.



Heretical Verities: Mathematical Themes in Physical Description *Thomas E. Phipps, Jr.*

Phipps' dedicated study of the advancement of physics is clearly shown with his work, which critiques Establishment physics, publications and thinking. This book is a must read for those "concerned with the foundations of physics and mathematics who have not been blinkered or blinded by a narrow professional education."—H. Pierre Noyes
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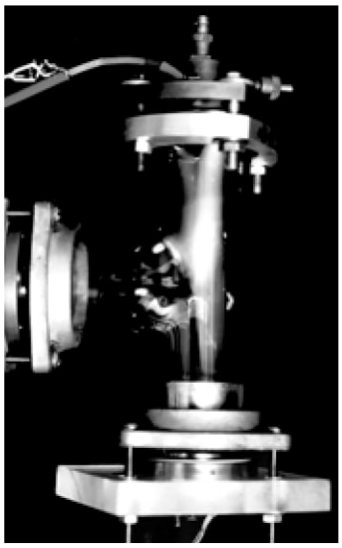

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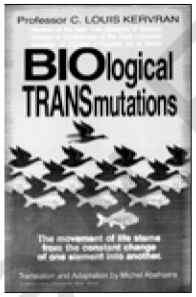

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Cover: Photo provided by Arnold Gulko. The photograph shows the electron beam chamber in operation; the cathode is a rod with its inner end sheathed in a blue plasma, indicating hydrogen. Extending from the cathode is an orange plasma, the color of which is drowned out on the film, apparently by strong ultraviolet radiation from the same region. Cover Art: Barbara DelloRusso.

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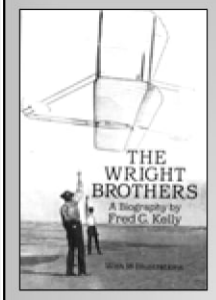

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Fred C. Kelly, 1989 (reprint), Paperback, 368 pp.
Includes special reprint of Jed Rothwell's "The Wright Brothers and Cold Fusion" article from *Infinite Energy*.
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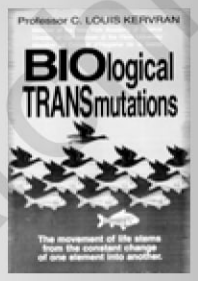

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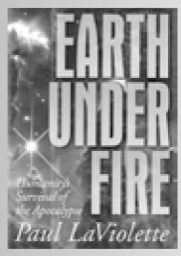

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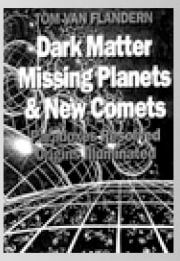

Dark Matter, Missing Planets and New Comets: Paradoxes Resolved, Origins Illuminated
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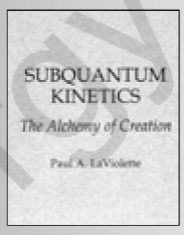

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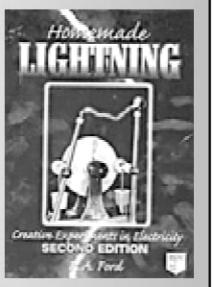

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Halton Arp, 1998
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New Energy and the News Media

by Eugene F. Mallove, Sc.D.

New energy, as I prefer to define it, is a source of energy of potential practical use that has heretofore been unrecognized by science. By this definition, conventional renewable energy, such as wind energy or solar energy put to practical use, are not new energies. The new energy that has become most prominent is, of course, cold fusion—or low-energy nuclear reactions (LENR) as some prefer to call it. Some would say that Dr. Randell Mills' hydrino energy, being pioneered by the apparently robust BlackLight Power Corporation, has come to even greater prominence than cold fusion.

Still others believe that both these new energies are closely related in their microphysical origin. Mills, and some cold fusion theoreticians who reject his theory, argue that there is only one new energy here; they think the other side must be mistaken. At least they are on the same side in a larger sense—both are considered "crackpot" science by the physics establishment and its servants in the news media.

It was of extreme interest to learn, therefore, of the preliminary combined gas- and solid-phase experiments and supporting theory of Arnold Gulko, which he describes in the cover story of this issue. Gulko suggests that low-energy beaming of hydrogen onto a boron-impregnated palladium (or other metal) target generates excess energy and is a bridge between fractional hydrogen (hydrinos) and cold fusion. He says that carbon (!) may be one quite visible reaction product and that there is inferential evidence of fractional hydrogen creation as well. Though Gulko's work is preliminary and may later be found wanting, it will be interesting to see what waves it makes in the new energy field.

Gulko does not have good calorimetry—not yet, merely indications of surprising, rapid temperature elevations, plus all the other observations he regards as supportive. We recall that Dr. Les Case's gas-phase catalytic fusion process, strongly confirmed now at SRI International, began that way too (see *IE* No. 20).

But the subject of this editorial is really new energy and the news media. One could write a lengthy tome—nay, a doctoral dissertation—about how the new energy cold fusion, as an example, has been treated by journalists. This small space could not do justice to the topic, but we want to remind our readers just how crucial the news media has been in molding public and scientific opinion in the direction that there are no new energies. The prevailing journalistic stance worldwide is that the concept of a new energy source, as defined above, is pure nonsense. That is why essentially all general media, business, and political discussions are constrained by this ground rule: our future lies with hydrocarbon fuel, fission nuclear power, and conventional renewable energy, and nothing else. Hot fusion is occasionally mentioned, usually wistfully, but rarely with abuse for not having delivered after fifty years of research. Cold fusion, by contrast, is mercilessly beaten up for not having produced commercial power reactors in the eleven years since 1989.

When we think of the role that *Infinite Energy* plays in the new energy vs. news media picture, we recall those rare, wonderful times when an open-minded journalist inquiring about cold fusion research chose to step outside the bounds normally set in mainstream journalism. We have been helpful in directing such strays from the pack to good sources of information, so that he or she could make an independent judgement. But as any watcher of the cold fusion/new energy scene knows so well, the times when unbiased news reports have appeared are as rare as hen's teeth. News media coverage is ordinarily little more than scientific bigotry—as unrestrained as racial bigotry when it raises its ugly head in a society.

Most often we are confronted with the chilling absence of any coverage. Thus potential new investigators at universities or in companies have no way of developing an independent judgement of our field. Equally serious, those who might financially support cold fusion/new energy must climb a very steep learning curve before even thinking about investing or rendering aid. Few survive the high-altitude ascent.

There are many practical difficulties in carrying out our mission, which is to serve as a timely source of quality reports about what is going on in the new energy field—science, technology, commercial activity, and news about political and media happenings that affect us. It is no easy task to do this in seventy-two pages six times a year, with very little advertising revenue to support the magazine—not for want of trying, we can assure you. Think about it: how many companies would be eager to advertise in a magazine which chronicles a field that has yet to blossom into a robust commercial or even a strong academic enterprise? So, this magazine would not exist without generous backers, and we honor them for what they have done. We receive revenue from our sales of books, tapes, and magazines, to be sure, but the current price of a subscription to *Infinite Energy* would have to be multiplied by a factor of ten for this to be a self-sustaining business. Very few of our readers would be willing or able to pay that much, even for an essential magazine.

Since this is our last issue of the Second Millennium of the common era, it behooves us to relate some other facts of publishing life, for all who have helped us—including benefactors, investors, employees, and every subscriber or person who in good spirit ever purchased a copy of *Infinite Energy* at a newsstand.

Many sacrifices have been made by numerous people, and this has allowed the magazine to survive into its sixth year. Though *Infinite Energy* is received in thirty-eight countries,

New Energy Times Archive

from the U.S. and Canada, to more out-of-the-way places such as Malta or Kuwait, it is a small magazine in terms of it circulation. We print some 5,000 copies bi-monthly, and send about 2,000 of these to newsstands. We believe that at least on the order of 4,000 to 5,000 people may actually read a particular issue of the magazine. Inexorably, new people come to the field. Many, however, also fade out as subscribers. In some instances they are disheartened that the technology side of new energy has not moved faster. In other situations, a reader may enjoy and understand the less technical material we publish, but is frustrated by the high technical levels in other parts. We remind everyone that, for now, we must have this smorgasbord approach—"something for everyone," because we have readers of very diverse needs, but are still too small to be able to publish more than one magazine. When more funding becomes available, we would like to expand on our efforts and publish a more popularized version of *Infinite Energy* and a fair peer-reviewed journal of new energy and new physics.

We are journalists trying to report to those involved in new energy research and to those on the sidelines curious about it, but we are also researchers who perform laboratory studies of new energy claims, attend scientific meetings, and deal with all manner of unrealistic, recalcitrant, crazed, and on occasion (rare, fortunately) quasi-criminal claimants. At the same time, our field is regularly degraded in the general news media as "pathological" or "junk" science. We do our best at PR to try to counteract that. Overall, we suspect that what we have undertaken at *Infinite Energy*/New Energy Research Laboratory is a unique enterprise. We are proud of it, though it is yet to be rewarding financially and is often extremely frustrating, even depressing.

We know we are not reaching everyone who might conceivably become a subscriber—this is proved over and over again by expressions of amazement from new readers who are thrilled with the vistas and process of science that are being revealed by investigators around world. One fantasy we have is to be able to "carpet bomb" a few dozen mainstream scientific conferences with tens of thousands of free issues of *Infinite Energy* every year, to see how many converts might emerge from the woodwork. Alas, we lack the resources to do any such thing.

However, we do send free copies of *Infinite Energy* to a select group of journalists, in the hope that they will begin to follow what is going on and perhaps write an occasional article. This has often born fruit, but sometimes of the poison-apple variety!

Recently, we were appalled that one Chet Raymo, a longtime science essayist with the *Boston Globe* and a physics professor at Stonehill College in Massachusetts, abused his complimentary subscription privilege. In an essay in the Health and Science section of the *Globe* on October 10, he attacked cold fusion research generally and *Infinite Energy* magazine in particular. His piece was devoid of any discussion of the scientific results and analyses that have regularly been provided to him as a courtesy in *Infinite Energy*.

Raymo unabashedly admitted in his essay, "I have neither the knowledge nor the time to evaluate a lot of the stuff in the magazine, but I think I know shaky science when I see it." He apparently employs "evaluation by intuition." We wonder if he teaches his students that claims on

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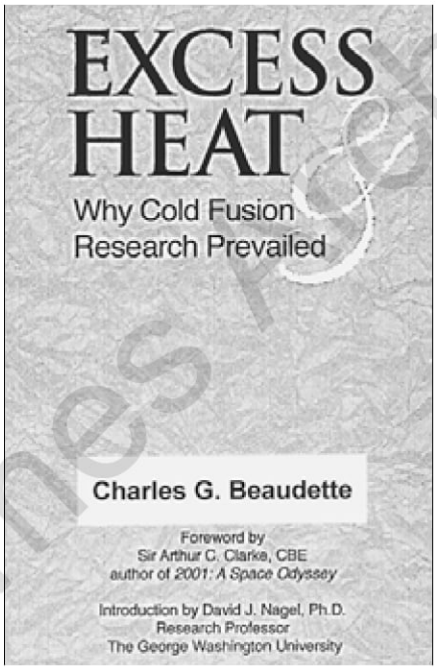

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"Charles Beaudette has done a remarkable job in untangling and documenting the whole story of cold fusion. Excess Heat is not only a superb record of an extraordinary episode, but is also highly entertaining."
—Sir Arthur C. Clarke

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LETTERS TO THE EDITOR

Cosmological Red Shift

I am uneasy with Halton Arp's peremptory dismissal of gravitation as the cause of the cosmological red shift. The conservation of energy requires that gravitation produce a red shift (fractionally proportional to M/r), and observation confirms that photons are subject to gravitational attraction; a black hole results when $M/r = c^2/G$. Although the gravitational red shift of the Sun is quite weak (about two parts per million), stellar masses between the Sun and the black hole leave a lot of red-shifting room. The gravitational red shift, of course, will be in addition to any Doppler red shifts that may occur.

Another issue raised by Dr. Arp is how the bipolar gravity singularities, strong enough to rip masses from the adjacent galaxy in the process of developing into quasars, originate. Is aggregated matter the source, or the result, of gravitation? Is it not possible that the initial quasar sites be masses without matter, i.e. sinks in the adjacent inertial space?

With so much both unknown and in controversy, both the science and politics described in *Seeing Red* (reviewed in *IE*, No. 31) has to make an exciting time in cosmology for both those involved and those merely looking on.

Charles Stuart
Titusville, Florida

Praise for Special Water Issue

I would like to congratulate Barbara DelloRusso, Dr. Mallove, and *Infinite Energy's* editorial staff for a masterfully composed edition. I think that it has turned out rather well, especially when considering that its topic is a "hot topic" (forgive the pun) these days. I trust and hope that it will evoke considerable discussion and I appreciate the many hours of work which have gone into getting this issue ready for publication.

Morad Eghbal
The Riess Institute, Washington, DC

Keep Up the Good Work

I read your magazine cover to cover, every word including the ads.

The University of Arkansas allows anyone sixty-five and over to attend the University free of charge. Next year when I become eligible I want to finish my Ph.D. I am reading your magazine to help fill in some of my education's gaps. I became aware of Dr. Randell Mills' book through your magazine and it is a monumental task trying to understand what is written there. I read *Infinite Energy* over and over and then go back to his book, understanding a little more each time.

Through Dr. Mallove's editorials, I feel a kinship and know exactly how frustrating and rewarding the path you all have chosen can be. As a scientific attendee to many conferences (medical diagnostic), there is always a "Dr. Paul" who has cement between his ears. So keep up the good work; it will pay off.

Patricia Hale
Rogers, Arkansas

Where is Coverage of BLP?

As a long-term subscriber (from the very first issue), I wish to register my first complaint. Recent issues have not, in my view, allocated coverage that seems proportionate to the real significance of the various efforts towards solving the energy needs and environmental problems bearing down on our civilization.

In particular, recent issues have slighted the accomplishments of the one organization that seems to promise a real breakthrough in commercializing overunity production of energy: 1) in terms of attracting large capitalization, 2) in numbers of scientific papers published, and 3) by patents granted or pending.

By any and all measures the paradigm breaker is BlackLight Power Corporation. Accordingly, I keep expecting to hear more of this effort from IE than I can get elsewhere. So I tear off the envelope of each new issue expecting to find out the latest on BLP, only to find articles on bicycles, tidal power, or water and your health! Sad.

In view of the epochal potential of the BLP saga, I can't understand why every news organization in the world isn't camped on their doorstep. Their accomplishments to date eclipse all competing efforts combined. Is this the story of the century? How about a special issue dedicated to Dr. Mills and his team?

Ed Crony
Glen Carbon, Illinois

Editor's response: We did have information about Mills in our special issue on water (see *IE* No. 33, Briefs page 49). We have had features about Mills in the past (see *IE*, No. 12; *IE*, No. 17; *IE*, No. 23) and hope to continue coverage as developments occur. Until then, all the information that is known about his work is currently on his website, in electronic forum discussions, and in published papers. We are a magazine about energy. We will continue to cover new technologies as they emerge as well as other areas of possible energy sources (such as tidal power). Given our small staff and budget to produce this magazine, we are doing the best we can to bring the information to our readers as it becomes available.—BDR

The Sage of Science Fiction: A Tribute to Sir Arthur C. Clarke

In February, *Infinite Energy* editor Dr. Eugene Mallove was asked to submit a written tribute to Arthur C. Clarke for presentation in an album of tributes. This collection was to be presented to Clarke this fall. We have just learned from Sir Clarke that the celebration took place on August 12, much to the surprise of Clarke. Below is a reprint of the tribute submitted to Clarke by Dr. Mallove, as well as Sir Clarke's thank you reply.

Sir Arthur C. Clarke

Dear Arthur,

You have been such a good friend and strong influence in my life and struggles during the "Cold Fusion War," it is difficult to know where to begin this tribute. First, thank you for facilitating last February's request by the Clinton White House for my Memorandum to the President, "The Strange Birth of the Water Fuel Age: The Cold Fusion 'Miracle' Was No Mistake." This is Exhibit A of your string-pulling

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for us all. (Think of what might happen if Bill actually took it seriously!) I am assured by Dr. Karl Anders and Wayne Houser that this letter and the Memorandum will become part of your Tribute book. Anyone who takes the time to read the Memorandum will get the full picture of what has happened in this seemingly interminable scientific controversy these past eleven years. If nothing else, they will realize that you did not "go off the deep end" in your support.

I was pleased to include some of your well-known aphorisms to introduce and close the memorandum to the President. They remind me of my experience as a sixteen-year-old in Norwich, Connecticut, reading your *Profiles of the Future* for the first time. I can now almost smell the grass of the mowed lawn as I read your ennobling projections of wonders to come. Sure, I was already a "space cadet," destined to enter MIT and become a certified astronautical engineer for what I thought would become a career of Mars- and Moon-base building. But your writings—I recall being much influenced by *The Sentinel* too, before "2001"— guaranteed that was the course I would pursue.

As it turned out, I did spend many years in engineering pursuits of a space-oriented nature, albeit mostly for the Department of Defense. Now that phase of life seems so far removed, since much more important matters have come up—cold fusion and free energy. These, of course, are destined to boost the real Space Age in the coming decades, and so much else. I hope you'll be around long enough to enjoy the beginnings of that fun. I strongly suspect that New Energy may even play a role in dealing with the threat of asteroid impact, which is of concern to us all. For now, you may be comfortable with the knowledge—the terminal babblings of Douglas Morrison, John Huizenga, and Robert Park notwithstanding—that your support for the New Energy revolution has been duly entered in the chronicles of the age. Every participant and supporter of this great cause cannot thank you enough for the words, spirit, and human resources you helped marshal toward the lofty goals we continue to pursue. It is not just new energy for which we strive, but the removal of the blinders that self-satisfied "old physics" has placed on humanity. More "miracles" will be in store when paradigm paralysis receives the greatest set of shocks since the happenings of 1895 and the few decades afterwards. The new physics revolution might yet make *Profiles* a bit tame! We shall see. . .

You helped us launch *Infinite Energy* Magazine and initiate investigations that might never have occurred had you not done the right thing. We thank you for this forever. Above all, we thank you for being steadfast and fair in your unwavering support. Our greatest pleasure will be to meet you in Sri Lanka or here in Bow, New Hampshire for the Great Victory Party. It's coming—hang in there!

Sincerely, Dr. Eugene F. Mallove

Saturday, August 12 was one of the most memorable days of my life and I am writing to all the wonderful people who made it possible.

It began when Hector and Valerie Ekanayake suggested a quiet evening for the family at the Galle Face Hotel. I suspected nothing, but soon after we arrived, friends I hadn't seen for ages kept arriving with good wishes, gifts—and finally four huge volumes of felicitations.

I am awed by the amount of work that Karl Anders, Wayne Houser, Brother Fred, and the Ekanayake family must have put into the operation. It still seems incredible that it was all done in such complete secrecy. The only similar occasion was when my TV producer, Simon Welfare, suggested shooting a few minutes in front of the Apollo Module in the Science Museum—and Buzz Aldrin emerged from behind it. Only then did I realize that I had been hijacked for the BBC's "This Is Your Life."

It has already taken me several weeks to go through the very touching tributes, and it will be even longer before I can answer them all. I sincerely hope before the dreaded year 2001 finally arrives!

Again, my gratitude and deepest appreciation to everyone.

Gene, hurry up with the victory party!

Sir Arthur C. Clarke, Sri Lanka

✍✍✍

Reflections on *Infinite Energy* Magazine
From Subscriber Susanna Felder

Dear Eugene Mallove:

Yes, I am happy to renew for another year. But I am writing to tell you why I almost didn't and to suggest an improvement for the magazine.

I have been getting *Infinite Energy* for several years, and I usually at least look through each issue, eventually, but I couldn't help noticing that for the last three issues, I haven't even taken them out of the envelope. Time constraints, mostly, but in addition, a general feeling that I wasn't finding what I want in it, which was why I almost didn't renew. My situation is this. I am a writer/artist, working for a church. My work has nothing to do with "cold fusion," but I believe in it, and all the new research that you are much closer to than I am. It is obviously the wave of the future. I had one year of physics at the college level, and am not afraid of technical talk, and have always loved "the sciences" just as much as literature and art, and my brother is an engineer (who still believes that any claim of "over unity" is likely to be bogus). He is a metallurgist and has his own steel fabricating company in western Pennsylvania. Very grounded stuff. And I have been paying attention to energy efficiency and "free energy" and "alternative energy" for years.

Nevertheless, a lot of the articles in *IE* are over my head, in the simple sense that I can't follow the thought very well. One of my original reasons for subscribing was to learn more about what research was going on, and I feel that I at least have some idea about what the articles are about, even if I can't follow every line of thought, just from slogging through most of each issue for a few years. More importantly though, I also wanted to incorporate any/some of these new technologies in my home, for heating and electricity production. But there was nothing on the horizon when I built my home in Georgia in 1990, so I had to make do with ordinary solar panels and passive solar design. In 1997 I moved to Montana and I am planning to build here, maybe this year, for sure by next year, and I figure, now I have another chance. What is out there that I can use (and preferably that doesn't cost a fortune)?

So my idea was: could you find a writer who could do

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more or a "popular science" type feature in each issue, talking about what is already useful, or nearly ready, or could be used if someone knew enough about how to put it together? Do you understand what I am suggesting here? I can't be the only subscriber who wants to try one out—heat my home or run my lights/computer/ sound system/water pump/etc. with one of these new technologies. The practical applications of "cold fusion" are there; isn't it time to start making some guesses about what is ready or nearly ready? What are some of those things that your advertisers make, for sale, about? Your techie readers already know this, but the rest of us are in the dark. It may be that most of your subscribers are techies or tinkerers or better, but maybe you would have more subscribers if you could pitch some of the writing to the general educated public. In fact, if you do come up with a "popular science" column, I will give my brother a gift subscription—he could probably follow some of the more technical stuff anyway and might actually get interested.

I think the magazine is actually very good. I can see that the technical writing is intelligent and worth following, even if I can't follow it. And, of course, the ads are as interesting as the articles. Just because I would like to be a little more concrete about some of what I have said above, I will go now and take Issue 28 out of its envelope and see how things look after I turn a few pages.

I am reading your editorial, "Breaking Through"—too bad about the Boscoli fiasco, but I am glad to see you can keep your spirits up, in spite of such energy-draining disappointments. I agree that it is the "stick-to-it-iveness" (as my grade school report cards called it) of the people doing the research that keeps the "bright shining hope" alive. However, I would point out one little thing re: the Great Turn-around. The "table-top demonstration device in wide circulation among high schools, colleges, and industry" will come at the end of the Great Turn-around, not the beginning. The beginning will be the breakthrough in the practical technology, marketed intelligently, that will heat and/or light thousands of homes and then hundreds of thousands of homes/shops/stores/company offices. . .and then schools and colleges, and then the table-top demonstrations will come, provided the practical technology has been satisfactorily "explained"—there are many out there like my brother, he tends to his business, but if you put the thing in front of him and he could see it working, he would not get in your way about it just because you couldn't explain exactly how it worked. A lot of Americans are simply pragmatic, in just that way. Let the explanations come, we will certainly be interested, but if it can heat my home, or power my car, or power my sound system, then I will plunk down hard-earned dollars for it, and the explanation of how it works is a distant non-concern.

I like your editorials. I always find them informative and readable, the one part of the magazine I always read, and I read you for the "pulse" of the industry. That is why I cringe when you start to get bitter. ("For all practical purposes, this field does not exist. Correction: It exists to be beaten up for sport by professional know-it-all hacks...") I like the "bright shining hope" stuff better. Because that is more real, and is the "energy" that will move us forward. "Cold fusion" is the wave of the future. There is no doubt about that. Fossil fuels and the technologies that require them are dinosaurs on the eve of extinction. That is clear. I think one of the things that might be holding the field back is the little matter of how dollar signs start to roll in front of people's eyes when they think about the first successful cold fusion home heating device, or the first successful cold fusion car. No doubt, there is a fortune to be made. But the spirit of science does not thrive in the atmosphere created by greed, especially hidden or unspoken greed. The "catalyzing demonstration" will come where there is a freedom and openness, a willingness to let the chips fall where they may, instead of trying to control everything to maximize one's own profit. I don't sense a lot of greed in most of your writers, but I know it is there, behind the scenes, in the field, and at least some of the hostility and cold fusion bashing comes from the greed plus envy of those who don't want anyone else to get rich from it if they can't, and they think the best way to keep anyone from getting rich from it is to ridicule it.

Anyway, I agree with the last paragraph of your editorial. "Gradualism" will serve only to keep the information flow somewhat alive. The real boost to the field will come from the "utilitarian" heaters and generators that will benefit people and the earth so much. Then the Wall Street Journal will sit up and take notice. Ironically, it seems likely to me that the Wall Street Journal interest will precede Scientific American or Science getting interested, just because the "theory" behind the whole enterprise is so anomalous too. Or, at least paradigm-threatening.

A good book, which I regularly revisit, is a little tome called The Wayward Gate, by Phillip Slater. The "wayward gate" of the title is Nature herself, and the book chronicles the whole sorry history of human ignorance having to be beat over the head with a two-by-four before the message sinks in. The "establishment" of the early nineteenth century ridiculed all reports of apes! This went on for over 100 years, with hundreds

Letters continue on page 68

"Websites Worth Your While"

http://www.noradsanta.org
To celebrate the holiday season, track Santa's sleigh progress via NORAD. On Christmas Eve, you can see up to the minute status reports of Santa's location across the globe. The site also contains interesting technical data about Santa's sleigh, as well as important tidbits such as how much food Santa consumes.

http://www.classmates.com
At this site, you can locate your high school classmates and watch for reunion information. You can view a list of all alumni registered for your school, or just your specific class. You must pay a registration fee in order to access contact information for your classmates, but it is free to add your name to the list to allow others to contact you and to periodically watch your class listing grow as more people hear about this interesting site.

http://www.borealis.com
This site has information about new developments in solid state cooling, including thermionic devices which operate near room temperature. There is also information about miniature motors.

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THE COLLAPSE OF MATTER

Excess Heat Generation, Fractional Hydrogen Formation, and Nuclear Reactions in a Gaseous Plasma

Arnold G. Gulko*

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Editor's Introduction

It is always a pleasure to introduce something very new to our readers, even if, as in this case, the experiments are of a preliminary nature—subject to possible errors or mis-interpretation. When we introduced Dr. Les Case's catalytic fusion work to *Infinite Energy* readers in 1998 and conducted our own preliminary temperature rise test, little did we know that by 2000 it would become almost the "gold standard" in cold fusion experiments. This has been especially so following the process's multiply-repeated excess heat generation at SRI International, which correlates well with helium production. Case's process uses heavy hydrogen gas and thermal activation. Now the beamed (electrically accelerated) *ordinary* hydrogen experiment of Arnold Gulko could be another significant advance for the cold fusion field. It offers heat generation at elevated temperature, possible evidence of a nuclear product (carbon!), and also the suggestion that *fractional hydrogen*—in Dr. Randell Mills' parlance, "hydrinos"—may be generated as part of the process. There is no spectral emission substantiation of this, merely inference by Gulko from the experiment's behavior. We encourage others to try to confirm these experiment claims.

Arnold Gulko is a retired patent attorney of long standing, with a strong chemical engineering background. He just happened to read a copy of Issue 17 of *Infinite Energy*, which contained our memorable interview with Dr. Randell Mills of BlackLight Power Corporation (conducted by Art Rosenblum). This inspired Gulko to resume his interest in cold fusion, which had been frustrated by the far less-than-ideal behavior of the U.S. Patent Office on his 1989 filing for patent protection for an earlier cold fusion idea inspired by the Fleischmann-Pons announcement. Gulko's application was denied, along with the filings of so many others—based on the tired mantra, "cold fusion does not exist." Now he says he has filed another patent based on the system described in this article. This straddles both cold fusion *and* fractional hydrogen generation by a method significantly different from that employed by BlackLight Power Corporation's publicly discussed approaches—catalytic potassium atoms introduced into a hydrogen plasma. Gulko's experiment employs a boron-impregnated palladium cathode that is hit with low-energy protons. In Gulko's view, elements other than palladium may turn out to work too, as long as they contain the critical boron or other catalyst mandated in his theoretical framework, the so-called "vortex theory."

It is interesting that Arnold Gulko comes to cold fusion and new energy from a theoretical background totally distinct from conventional nuclear models of the cold fusion field—also very different from Mills' hydrino model. Gulko has spent many years developing an *aether vortex model* of protons, neutrons, and electrons, which he suggests has greater explanatory power for chemical, nuclear, and cosmological phenomena than conventional atomic/nuclear models. He has extended the work of Carl Frederick Krafft, his colleague at the USPTO. (Krafft's tenure (1913-1963) overlapped Arnold Gulko's position as an examiner at the USPTO from 1947 through 1952.) Readers who are interested in pursuing Gulko's aether vortex (perfect fluid vortex) models of subatomic particles are encouraged to read his several books on the subject, which are available for purchase on his website.

—Eugene Mallove

Fractional hydrogen does not exist on Earth, but Randell L. Mills reported in an interview in *Infinite Energy* (Vol. 3, No. 17) that it exists in space. Mills said that he had produced it in laboratory experiments to provide a new energy source, using potassium in the +2 ionic state to remove an unusually large amount of energy from normal hydrogen.

Fractional hydrogen describes hydrogen in a fractional quantum state in which the hydrogen electron has lost more than the usual 13.6 electron volts of energy to form a collapsed mono-atomic structure, which Mills calls a hydrino.

On reading that report, I tried to produce fractional hydrogen using my understanding of how it might be formed. My partner, Malvin Beller, and I modified a conventional electron beam device we had obtained as surplus from Cornell University, hooked it to a supply of ordinary hydrogen gas, and began to experiment.

During 1999 we encountered some confusing results using hydrogen gas at low pressure, but we still obtained at least an 11°C temperature rise over a portion of the apparatus using only about 5 watts of input power. Since the hydrogen confined within our 20-inch-long chamber was present at a reduced pressure to allow us to ionize it with our limited direct current power supply, we encountered difficulty because the ionization chamber walls released adsorbed gas over an extended period of time. Also, the desired actions required a great deal of time to develop. However, the elevated temperatures were present over an extended period of time, and they were much higher than when *air alone* was present in the chamber. So it seemed clear that the released energy was in excess of anything which might be attributed to the small amount of hydrogen used to replace the air, especially since there was no significant rise in temperature when hydrogen was first used.

Continuing our work during 1999, we encountered more confusing results, but some of the temperatures obtained were above the boiling point of water; these higher tempera-

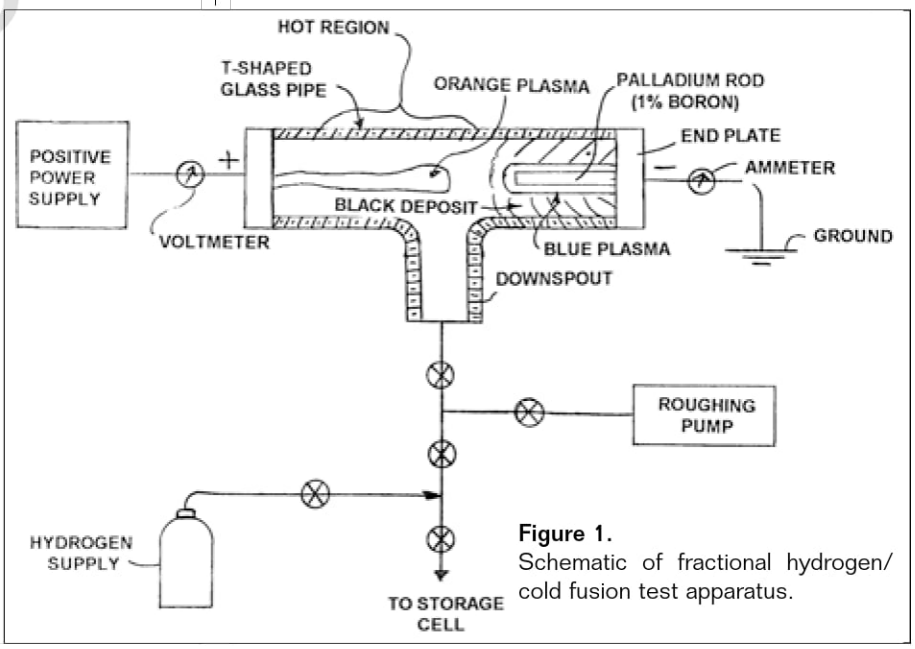

Figure 1. Schematic of fractional hydrogen/cold fusion test apparatus.

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Photo courtesy A.

Arnold G. Gulko (L) and Malvin Beller in their laboratory.

tures were encouraging. But our measurement of the electric current used was not accurate and we found our equipment needed further modification. These modifications avoided the need for low pressure. We also interposed a Fluke digital electrical meter between the cathode of the electron beam apparatus and the ground and thus obtained a more reliable measure of the milliamps flowing through the electron beam chamber.

Events progressed much more rapidly using the modified equipment. We were able to experiment at higher pressures at which the removal of gas from the chamber walls was no longer a problem. The generation of heat in our smaller modified equipment was much more rapid. Indeed, the temperature rise was so rapid that in one two-minute run starting at ambient temperature, we obtained a localized temperature above 183°C, so we turned off the electric current to protect our glass chamber. Despite quickly turning off the electric current, this high temperature formed a bubble in the glass near the region of highest temperature, but fortunately this did not destroy the chamber.

The discussion which follows is provided to enable one to understand what was done, its relationship with what has been observed in space, and the curious results which have been obtained. Some of these results may have scientific and commercial importance extending beyond the provision of useful energy, which was the main objective of the experiment.

We live in a world of ordinary matter, but we know that matter of a very different sort exists, albeit we do not know its nature. That very different matter is collapsed matter. How do we know that collapsed matter exists?

When we look out into space we find objects which, while very massive, are very small. Some of these cannot themselves be seen and are called black holes. Since we cannot see whatever constitutes a black hole, physics can only speculate about its nature. But while we cannot see what constitutes the black hole, we can calculate the mass of the hole by the orbital motions it induces around it. Some very small visible objects which have been photographed are also very massive; these are called neutron stars. The mass of a neutron star can also be judged by the orbital motions it induces around it.

So neutron stars exist and have very small size relative to their enormous mass. A neutron star, the pulsar in the Crab Nebula, has a mass of about 1.4 solar units (one solar unit is the mass of our own Sun), while it has a diameter of only about 7 miles (so tiny it would fit within the District of Columbia).

Thus, while normal matter has a density in the range of 1 to 20 grams per cubic centimeter (g/cm^3), a neutron star has a density of 10^{12} g/cm^3; that is of the same order of magnitude as the density of the atomic nucleus.

Neutron stars are now recognized to consist of a "nucleus" of enormous size, but here on Earth where the density of matter is much lower, any atomic nucleus with more than 92 protons is rapidly unstable. But a neutron star is a stable entity in the sense that while high energy polar jets may issue from it when matter from a surrounding accretion disk falls upon it, the star itself remains in place and does not explode. Physics is baffled by the problem of how a nuclear structure of such enormous mass might be relatively stable, but that problem will not be addressed here. Instead, we will accept the fact that matter *can* collapse, because only collapsed matter could provide the density

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possessed by a neutron star.

The problem we shall try to cope with is the differences between the matter around us and what that same matter would be like if we collapsed it, even to a minor extent. This problem arises because Mills claims he has been able to collapse hydrogen to a fractional quantum level to obtain considerable energy. Those wanting additional information about Mills' work can reference his website at www.blacklightpower.com.

Mills has been criticized on the basis that there is no spectral line corresponding to the lower electron energy states which he asserts exist. This criticism was advanced while ignoring Mills' insistence that though these lines were not present naturally on Earth, they *were* present in light from the solar corona and other objects in space. The experiments reported here shed light on this controversy.

Let us start by reviewing some simple properties of the matter around us to allow comparing these properties with the observations we encountered in our attempt to obtain fractional hydrogen. We proceeded in a different way than has been described by Mills, who suggested that the use of potassium in the +2 ionic state was crucial.

Our electron beam apparatus, as shown in Figure 1, is constituted by a glass chamber with a standard T-shaped glass pipe having an anode at one end, a cathode provided by a ground at the other end, and a downspout intermediate between the two ends, which is connected to a mechanical roughing pump that can provide a vacuum of about 30 millitorr. We used the pump for about one day to remove gas adsorbed on the chamber walls; when much of this gas had been removed, a vacuum of about 30 millitorr was obtained.

Any direct current source can be used which supplies a controlled high voltage (we had up to about 3,000 volts available) at low amperage (we usually drew from 2 to 50 milliamps, but sometimes we drew as much as about 130 milliamps). In our apparatus we used a positive voltage power pack to supply the current used to power the electron beam. Since the glass pipe was 8 inches long, 2 inches in internal diameter, and 0.25 inch in thickness and since the cathode was constituted by a stainless steel end plate carrying a rod extending into the chamber, our 3,000 volts allowed us to obtain a plasma while the gas within the chamber was close to atmospheric pressure (about 1,600 millitorr).

With air in the chamber at a pressure of 1,500 millitorr, we obtained a plasma with about 500 volts, and this plasma was stable in that its characteristics did not change with time. We could control the voltage, but not the amperage, so with air only about 2 to 5 milliamps of current moved through the chamber. The temperature rise across the chamber was uniform and limited to about 2°C. above ambient temperature. After removing the air and flushing several times with hydrogen, we found that a slightly lower voltage produced a plasma using hydrogen at the same pressure, but at the start no more heat was encountered with hydrogen than had been encountered with air.

The cathode we employed is a crucial element in our experiment, and it included an end plate carrying a palladium rod 0.25 inch in diameter and 2 inches long, which was cast to include about 1% by weight boron. Palladium is a metal which has a great capacity to absorb hydrogen, as those knowledgeable about efforts to obtain cold fusion in aqueous medium are well aware. The use of boron was predicted by this writer in 1989 to be important to cold fusion efforts, and this prediction has now been confirmed. It is here found that boron is important to the production of fractional hydrogen. [*Editor's Note:* Studies at SRI International and elsewhere have on occasion found boron additive to be effective in electrochemical cold fusion experiments.]

My vortex theory (the subject of twelve texts that I have published since 1980, three of which relate to basic physics) suggests that boron-11 contains an electron-terminated neutron, which gives it the capacity to catalyze the conversion of hydrogen to fractional hydrogen. This is because as hydrogen is formed, energy from the electron is pulled away to the proton, which returns it to the electron to provide an energy shell which keeps the particles apart, despite the electrostatic force, which should draw them together. When the proton is close to the negative end of a neutron, some of the energy circulating between the particles is drawn off to the neutron, forcing the electron to lose more energy than it normally does when hydrogen is formed. In this way the loss of energy, which leads to the formation of hydrogen, is continued until the hydrogen atom reaches a frac-

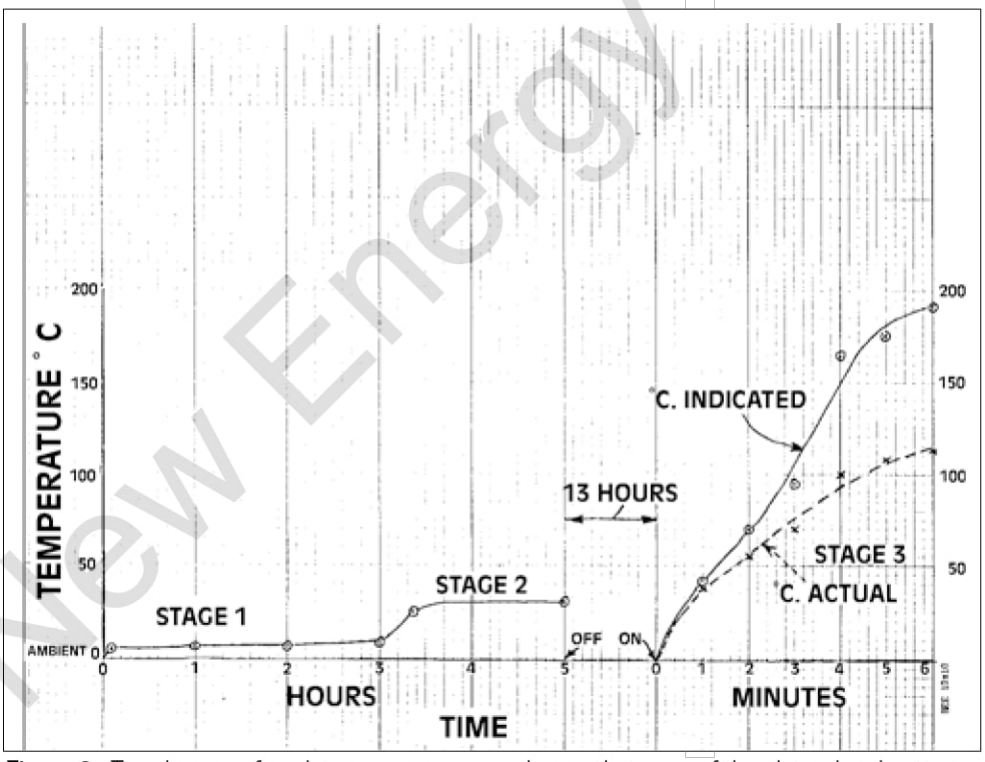

Figure 2. Time history of peak temperatures near the anode region of the glass chamber in one experiment. Temperatures were measured with an Omega OS-88000-K-1200 hand-held infrared probe. "Indicated" temperatures (on the digital read out), were adjusted downward to "actual" temperatures, per the Omega instructions. Near room temperature, little correction is

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tional quantum level. This action is enhanced (made more rapid and continued to a lower quantum level) when the hydrogen is electrostatically concentrated within the cathode to generate a pressure which forces the hydrogen into intimate contact with the boron catalyst.

Gases mix easily with one another. Liquids, on the other hand, sometimes mix easily (like water and alcohol), but sometimes they are incompatible and repel one another (such as water and oil). Unlike liquids, the gases known to us are always compatible with one another and they also flow easily, even through a small diameter tube such as the 0.125 inch diameter copper tube that we use to supply hydrogen to the ionization chamber.

Gases in an electron beam apparatus are subjected to a stream of electrons moving from the cathode to the anode. As the electrons stream through the ionization chamber, it is known that they knock electrons off the gas atoms or molecules within that chamber to produce positive ions, cations. These are positive because they contain one more positive proton than negative electron, and as the name "cation" implies, they electrostatically migrate to the cathode. So gas molecules within the ionization chamber concentrate in and around the cathode, but not near the anode. Electrons possess a much lower energy density than protons (by a factor of about 6 billion to 1), so the moving electrons under consideration cannot knock loose any protons they may encounter to form an anion which might concentrate at the anode.

When the positive particles and the electrons associate with one another in an electron beam chamber, energy is released and is usually visible as a light emission. When air is in the chamber the light is usually white and is striated (portions of light emitting gas are separated by portions of gas which are dark). When hydrogen is in the chamber it is also striated and is usually pink to blue in color, depending on the concentration of the hydrogen.

If fractional hydrogen were formed, it was expected to be formed within the palladium cathode, so one would anticipate the release of energy should be concentrated in the cathode region of the chamber. Accordingly, while operation of the electron beam apparatus could be expected to

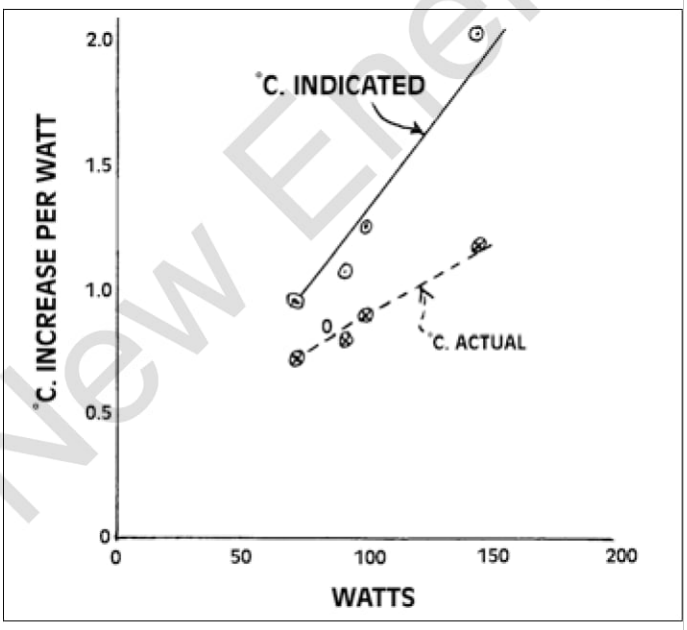

Figure 3. Increase of temperature per watt of input, plotted

warm the cathode portion of the ionization chamber if fractional hydrogen were formed, one would not expect any significant temperature rise or concentration of heat remote from the cathode. In fact no significant temperature rise (more than 3°C) was noticed at the start of our experimental effort, but shortly thereafter the temperature did begin to increase, and the initial increase was concentrated near the cathode, as discussed above.

If fractional hydrogen existed, its small size might make fusion reactions take place at a lower energy level, so some limited consideration of thermonuclear fusion is needed.

America has already expended more than $20 billion to try to obtain controlled thermonuclear fusion, using what is today regarded as the easiest possible hot fusion reaction, namely, the fusion of deuterium with tritium. Using a large tokamak reactor at Princeton to obtain the high temperature and confinement needed, it was possible to obtain about 50% of break-even. This means only about half of the energy supplied to the fusion reactor was released in the fusion events produced. But the achievement of break-even had been predicted, so the experiment was really a failure. Following this failure America declined to continue the prior large fusion appropriations, about 800 employees lost their jobs, and the Department of Energy is no longer goal-oriented, albeit research is continuing.

As a rule of thumb, other possible fusion reactions are considered to be more difficult in direct proportion to the number of protons in the element to be fused. Thus, the fusion of boron (which contains five protons) with hydrogen is usually estimated to require about five times more energy than is needed for the fusion of deuterium with tritium.

Boron has been fused with protons by accelerating protons to high energy and firing them at a boron target, but the action is not efficient. Boron in nature is a mixture of isotopes of which about 90% is boron-11. Boron-11 can capture a proton to form a compound nucleus of carbon-12. But since boron-11 and a proton together contain more energy than normal carbon-12, this compound nucleus was unstable and decayed into three alpha particles. An alpha particle is a helium-4 nucleus.

Our electron beam apparatus operating on house current cannot form ions containing more than a single positive charge, and it should not provoke a reaction between the boron and hydrogen, because the energy level is far too low. If that reaction were somehow provoked, the present knowledge noted above suggests carbon would not form.

Also, the operation of an electron beam does not alter the gas within it. Under given conditions the nature of the plasma remains the same, the amount of electricity which maintains the plasma is constant, and the heat generated is small and constant. Moreover, the thought that the gas being ionized would change its character while the electron beam sat idle at room temperature is sheer nonsense.

Now that we have reviewed the known attributes of the matter around us and some of the knowledge relating to electron beam operation, we can consider the results we obtained, and it will be understood why these are confusing.

Several curious things happened as we maintained the plasma. First, the temperatures kept going up, and this does not happen with any ordinary plasma. As noted previously, the initial rise in temperature, albeit only about 12°C, was mostly at the cathode end of the ionization chamber, and this was where we had hoped to find it. Second, the appearance of the plasma changed, and this is unusual. At the start, some stria-

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tions which filled the chamber appeared near the anode and the cathode was covered with a thin, light-blue plasma which covered the end plate as well as the rod that extended into the chamber (see photo on the cover of this issue). But as time passed, the blue coloration deepened and that blue plasma withdrew from the end plate and was confined to the rod. Also, the striations at the anode end were no longer present and the plasma at the anode took on a cream coloration. Third, the voltage increased slowly, even though nothing was added or removed from the chamber and the current setting was not changed. Fourth, the temperature kept increasing, and now the highest temperatures were concentrated at the anode portion of the chamber.

The increase in the resistance of the gas in the chamber is of special importance, because there is nothing present to cause this increase. But the increase was unmistakable. To illustrate this, we could not monitor the apparatus continuously, especially at night. But when the apparatus was left unattended, the voltage would increase until, when we returned, the plasma had shut itself off and the higher voltage present when that happened still showed on the voltage meter.

On one occasion we turned off the current late one evening, when only 13 watts were flowing through the plasma, and only a moderate temperature was present. About 13 hours later we re-started the plasma to find that maintaining the re-started plasma required 71 watts. The characteristics of the gas sealed within the chamber had changed as it sat around at room temperature. Also, as operation proceeded it became progressively more difficult to re-start the plasma, and here one must recognize that it takes a higher voltage to start the ionization of a gas within the chamber than it does to maintain that ionization.

So the gas within the chamber became more resistive, and as this increased resistance was encountered, the current flow to maintain the plasma increased, the heat generated increased, and that heat became progressively more concentrated at the anode portion of the ionization chamber. Also, the appearance of the plasma changed whenever it became highly resistive. The layer of blue plasma around the rod became thinner, brighter, and more vividly blue in appearance, and as the resistance became greater this blue plasma covered a progressively smaller length of the free end of the rod.

But the appearance of the plasma at the anode portion of the chamber provided the most striking change. First, this anodic portion of the plasma acquired a distinctly orange color and it extended from the anode toward the rod, but it never actually reached the rod. Moreover, this orange plasma was confined to the central portion of the chamber as a continuous shaft of light. The greater the resistance as measured by the power required (voltage times the amperage is the power in watts) the narrower and brighter this orange plasma and the closer it came to the rod. As the resistance increased the temperature rise was much more rapid.

When the plasma was most difficult to re-start and the orange portion of the plasma was the narrowest, brightest, and extended closest to the rod, the voltage was 1150 volts and 128 milliamps were measured (so 147 watts were supplied to the chamber). The temperature rose rapidly, producing a peak temperature at the top of the glass chamber above its anode region in excess of 183°C in two minutes. In this same experiment, after one minute the anode temperature was 95°C and the temperature at the end of the rod was 75°C, these last two temperatures being measured along the center line of the chamber.

Estimating a 50°C average increase in temperature over ambient (in one minute) suggests a ratio of watts of heat output to watts of electricity consumed in excess of 3:1, and there is nothing other than the heat-releasing capacity of fractional hydrogen to account for this. With such high temperatures being reached so quickly, and with so much excess heat being generated, the power was turned off after only two minutes; our limited voltage would not permit the plasma to be re-started. The high temperature produced a small bubble, which is visible in the top of the chamber above the end of the cathode rod. The orange color so evident to the eye could not be photographed, being drowned out by strong ultraviolet emitted from the same region.

In order to continue, we added a small amount of hydrogen (which increased the pressure) and then reduced the pressure. This enabled the plasma to be re-started, but then we had to wait for the gas to "cook" before the increased electrical resistance enabled a rapid increase in temperature to again be experienced. Since normal hydrogen is easily ionized while fractional hydrogen is not, increased resistance is attributed to a reduced proportion of normal hydrogen within the chamber, and there is nothing other than fractional hydrogen present to consume it.

The question of what gas could so vigorously resist ionization at the same time that some gas was providing a bright orange-colored plasma provides a significant puzzle. Also, something was concentrating at the anode end of the chamber to provide the primary heat source, and in ordinary electron beam operation, everything other than the electrons is positively charged and must concentrate at the cathode.

Another strange event took place with continued operation. At first the glass of the chamber walls was clear. But with time a black deposit was seen at the cathode portion of the chamber, and that black deposit kept getting larger and darker!

There is no source of carbon in the chamber, so one must wonder about the source of this black deposit, which so resembles ordinary soot. While I could contemplate the possibility of reaction between boron-11 and the proton of fractional hydrogen, I knew this resembled the previously described known reaction which did not produce carbon, but helium. So the formation of a black deposit in the electron beam apparatus was puzzling.

Let us now consider all of these various and apparently unconnected puzzles from the perspective of the formation of fractional hydrogen at the cathode, which is where we expected it would be formed. In this consideration we must recognize two characteristics of fractional hydrogen asserted to be present by Mills. First, and as part of the previously referenced disclosures, he insisted a very large amount of energy was released as the hydrogen atom collapsed. This, he asserted, would not only provide a source of heat, but it would produce a mono-atomic hydrogen atom which was much smaller than normal, and that atom would be chemically inert (it would resist ionization), because it would take a great deal of energy to remove the electron from its close association with the proton. Second, in a subsequent disclosure Mills reported his fractional hydrogen picked up a second electron to become chemically reactive. Mills suggested this capture of a second electron provided a new branch of chemistry, which he and his associates are pursuing.

Let us confront the fact that the portion of the plasma

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near the anode was of orange color and was confined to the center of the chamber where it was surrounded by gas that did not capture any electron and remained dark. The presence of fractional hydrogen which resists ionization would explain the dark gas near the outside of the chamber. Also, a pink to blue color characterizes a hydrogen plasma, so something else is the likely source of an orange-colored plasma. At the same time let us also confront the fact that after an initial period in which most of the heat was released in the cathode region of the ionization chamber, most of the subsequently generated heat came from the anodic region of the chamber.

It is weird to have a single plasma with two markedly different colors at the opposite ends of a single ionization chamber. However, if fractional hydrogen were formed and captured a second electron, that capture would produce a differently colored light emission. Also, the capture of a second electron provides a negatively charged structure called an anion. Anions electrostatically concentrate near the anode. So the capture of a second electron by fractional hydrogen should cause the fractional hydrogen to concentrate near the anode, and reaction of fractional hydrogen so-concentrated with itself or with normal hydrogen could provide a source of heat. This provides a logical explanation for the fact that the release of heat shifted from the cathode, where the normal hydrogen concentrated, to the anode where the fractional hydrogen concentrated.

But the anode pulls electrons away, so fractional hydrogen reaching the anode is neutralized and should be present as a neutral mono-atomic atom. It is clear that this atom should be chemically inert and difficult to ionize because its single electron is so strongly held. This would explain the dark region around the central orange portion of luminous plasma. But how can one explain the apparent incompatibility of this ionization-resistant gas, for we had difficulty withdrawing the highly resistive gas from the chamber?

If an atom of fractional hydrogen can combine with a free electron, it might also associate with the electron end of another fractional hydrogen atom. This would fill the chamber with clusters of tiny fractional hydrogen atoms as well as atoms and molecules of ordinary gases which are much larger. Logic suggests these much larger atoms and molecules would have difficulty penetrating a cluster of tiny atoms. So the formation of an incompatible gas is logical if fractional hydrogen had been produced, and this means observation of incompatibility in the gas phase documents the formation of fractional hydrogen.

After some of our experiments ended by our inability to ionize the gas in the chamber with our available voltage, we tried to withdraw gas from the chamber through the 0.125 inch diameter gas line to an evacuated cell. We should have been able to do this easily with any ordinary gas in the chamber which was at close to atmospheric pressure. But our roughing pump could not penetrate the small diameter gas line to reduce the chamber pressure, and this resistance indicates the gas atoms in the chamber might have "clumped together" to plug the line.

As our electron beam apparatus was operated, a dark black deposit was observed to form near the cathode. With continued operation this black deposit became larger and denser until it filled the region from the cathode end plate to the mid-point along the length of the T-shaped pipe. No black deposit was ever seen when the electron beam chamber was not producing large amounts of heat, so such a deposit is not the result of the plasma within the chamber. Accordingly, there is no logical source of carbon in our electron beam apparatus, except for the transmutation of boron by its reaction with an atom of fractional hydrogen.

Confronting the nuclear interaction between boron and the proton of fractional hydrogen, it is known that reduced size eases nuclear fusion, and here the fractional hydrogen atom possesses reduced size. This is illustrated by the fact that a muon atom with a proton (which is much smaller than hydrogen) will fuse with deuterium or tritium at very modest temperature without confinement, albeit the instability of the muon prevents this from being practical. But as the fractional state of the hydrogen atom is reduced two things happen. First, a great deal of energy is taken from the hydrogen electron and released. Second, the fractional hydrogen atom becomes progressively smaller. The possibility that the boron in the cathode will fuse with some of the fractional hydrogen is evident. But how is it that carbon is formed when the normal fusion of a proton with boron-11 does not form carbon?

If nuclear fusion is to take place with the proton of a fractional hydrogen atom, then the energy taken from the electron of that atom must be returned to its electron before fusion can occur. Accordingly, when boron-11 fuses with fractional hydrogen, one obtains a compound nucleus of carbon-12 containing less energy than if it were formed by reaction of boron-11 with a high energy proton. This reduced energy content apparently enables that compound nucleus to remain as carbon-12 rather than to decay into three alpha particles, as occurs when a proton is accelerated and fired into a boron target. Avoidance of the expected formation of alpha particles when boron captured a proton still further establishes the formation of fractional hydrogen and the formation of carbon-12 in the absence of carbon-13 has obvious significance for the formation of perfect diamonds. It should be recognized that the finding of carbon is suggested by the black deposit formed only when excess heat is generated, and has not been verified yet by analysis of the deposit. [While some boron-proton fusion is likely, preliminary examination now suggests the black deposit is palladium.]

Certain characteristics of collapsed matter can be discerned from our experiments. First, the proton in a collapsed structure has the capacity to act in a di-valent manner, whereas the normal proton is mono-valent. Second, collapsed matter can interact with normal matter to cause it to collapse. Third, collapsed matter has an enhanced capacity to enter into fusion reactions. These factors are thought to have importance in the formation of neutron stars in nature.

To summarize, several results which seem to be impossible in existing thinking have been obtained. For one thing, the existence of fractional hydrogen and its capacity to loosely capture a second electron have been corroborated. Also, the possibility of using fractional hydrogen in fusion processes has been demonstrated. Moreover, a new source of energy to fill the needs of man for the future has been established. While I have filed a patent application on what has been done, there is still much to learn before one can know the commercial potential of this achievement. Thus, the ionization chamber can be placed under water to limit the chamber temperature and boil the water, but much must be done to make this a practical power source. On the other hand, when the heat used boils water, it is easy to determine the amount of heat generated in any given amount of time, albeit the

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results already obtained make it clear that a large amount of excess heat has been produced. The generation of excess heat has proved extremely repeatable over many weeks of starting and re-starting the experiment. Certain control experiments using non-boron containing cathodes, such as iron, as well as boron-containing iron cathodes, are planned.

With respect to my background that got me into this scientific adventure, after obtaining a degree in chemical engineering I became an Examiner in the United States Patent Office in 1947, where I worked under Carl F. Krafft, who initiated the vortex theory which I have pursued these many years. Krafft died in 1969, but before his death he began to question his own thinking, because he could see that his proton was structured to be able to capture *two* electrons whereas, in the nature around us, it only captured one. We now see that in fractional hydrogen a second electron can be captured. After Krafft's death, and despite being actively engaged as patent counsel until 1989, I began to devote more and more of my time to the development of vortex physics and the astrophysics which that physics demanded. While everything seems to me to be confused in modern physics, vortex physics progressively made more and more sense out of the nature around us. Indeed, it even provided the only astrophysics which has predicted some observations made by the Hubble Space Telescope, which continue to astound conventional thinking.

Since I prefer to move down the abstraction ladder and discuss relevant details, we are here considering hydrogen, and physics still does not know how the electron remains at a great average distance from the proton despite electrostatic attraction. Rutherford and Bohr postulated orbital motion to balance that attraction with angular momentum, but the angular momentum of the electron in the ground state hydrogen atom is zero. Moreover, in the normal di-atomic molecule, H_2, the electrons pair between the two protons. But the pairing of two mutually repellent negative entities provides an evident absurdity.

While the problems noted above are those relevant to the hydrogen discussed herein, there are many such problems, and they confuse anyone trying to think in modern physics. Logical solutions to these problems are set forth in my texts.

Vortex physics importantly organizes the elements on the basis of their nuclear structure. This provides isotopes, like boron-11, with a peculiarly different "extra" neutron (an extra neutron is one in excess of the number of protons). It is this ability to rely upon the nuclear structures of the elements which led me in September 1989 to file a prophetic patent application on the use of a boron catalyst in a palladium cathode to improve the performance of cold fusion. That application was rejected. Indeed, it was rejected as obvious in view of the "prior art," which illustrates the inanity of present Patent Office practice. We now know the cold fusion process is considerably improved by the use of boron in the palladium cathode (see Table 2, Storms, E. 2000. "A Critical Evaluation of the Pons-Fleischmann Effect: Part 1," *IE* **6**, V. 31, p. 18) . This improvement is still not understood now that we know it works, which shows how non-obvious it really is, but it was evident to me from basic theory eleven years ago.

Those interested in my texts can obtain them from me or obtain further information from my web site:

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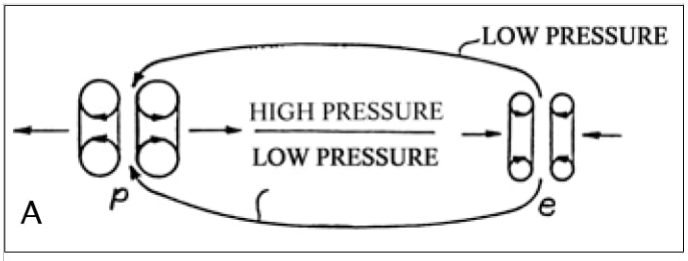

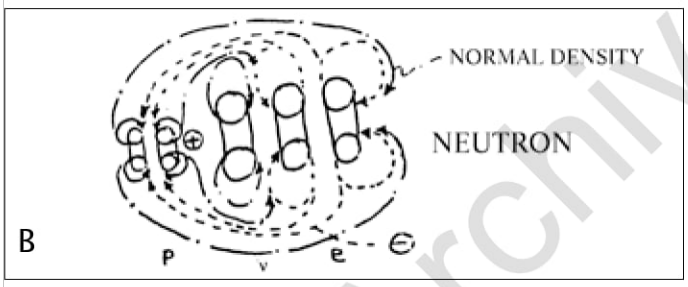

Sample schematic diagrams from
The Vortex Theory (Second Edition, 1985) by Arnold G. Gulko

A. (p. 39): The Coulombic attraction between oppositely charged particles (p = proton, e = electron). The (vortex) ring of the electron which faces a proton spins in the dense fluid which propagates away from the proton, so this inner ring dominates and pulls the electron toward the proton. The facing ring of the proton spins in the dissipated fluid, which propagates away from the electron, so the outer ring of the proton dominates and pushes the proton toward the electron.

The ring of the electron, which faces a proton spins in the dense fluid which propagates away from the proton, so this inner ring dominates and pulls the electron toward the proton. The facing ring of the proton spins in the dissipated fluid which propagates away from the electron, so the outer ring of the proton dominates and pushes the proton toward the electron.

Coulombic repulsion and attraction thus follow logically and inevitably from the only possible positive and negative two-ring fluid structures and from the high and low fluid densities which these structures must necessarily produce.

It should be kept in mind that the fluid which is circulated by the charged particles is not only densified or dissipated, but it is oriented by the propelling action of the particles. The charged particles seem to have an affinity for oriented fluid so that the same fluid is circulated again and again, either by a single particle, or back and forth between associated particles. This circulated fluid is thus part of the particle. Also, the fluids are capable of transmitting forces directly so that the dense fluids emitted by two protons will ram against one another to create a repulsion. This will explain some of the proton's properties.

The mystery supplied by nature is the ability of the electron to remain at a distance from the proton despite electrostatic attraction. This spacing is the result of the exchange of fluid between the particles in combination with the greater concentration of dense fluid which is circulated by the smaller rings of the massive proton in comparison with the smaller concentration of fluid which is circulated by the larger rings of the electron. The electron's low concentration circulation cannot penetrate the much greater concentration of energy around the proton. As a result, the light electron encounters the proton's concentrated outward polar flow when it comes too close to the proton, and is hurled away. This prevents the rings of the electron from engaging the rings of the proton which is a mutually destructive encounter.

B. (p. 72): Vortex composition of the neutron—an electron, proton, and anti-neutrino. In the composite neutron shown, the antineutrino (⊠) is in rolling contact with both the electron and the proton, and it thereby eliminates the conflict in flows which previously held the electron away. Dense fluid is shown by solid lines and fluid of reduced density is shown by dotted lines. It will be seen that the neutron is surrounded by shells of oppositely charged fluid, and that the outermost shell is of normal density which conceals the opposite charges from the outside world. This structure can be compared with the neutron's structure determined by R. Hofstadter in 1961 which is reported by L. Pauling and P. Pauling in *Chemistry*, W. H. Freeman & Company, page 683 (1975).

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An Energy Amplifier Device

U. Mastromatteo*

Paper presented at ICCF8, Lerici, Italy (May 2000)

Abstract

After more than ten years from the beginning of the experiments, in laboratories of many countries, aimed to confirm the phenomenology claimed by Fleischmann and Pons in March 1989, in which the lattice of hydrogen-loaded metals nuclear reactions can take place at temperatures not above a few hundreds degrees centigrade, the scientific certainty of this possibility has been achieved.

Actually, the work of cold fusion experimenters is now mainly devoted to finding the best technological approach to activate these phenomena in a reproducible, efficient, clean way. A more attractive approach uses a simple nickel layer at high temperature in a hydrogen environment. Many experiments using this kind of approach demonstrated a very interesting correlation between excess heat coming from hydrogen-loaded nickel and electrical, thermodynamic conditions of the system.

Using a peculiar system configuration devoted to the qualitative study of these phenomena, in recent experiments it was possible to evaluate approximately the average micro-system amplification. Moreover, in the spots where excess energy melted the material, the amplification was estimated to be larger than ten. Under way is an effort to change the system to control, with a suitable feedback block, the local amplification values, in order to extend them in a stable way to the main part of the active material. A general partitioning of the Energy Amplifier System is shown in Figure 1.

Introduction

In a previous paper[1,2] we described the preliminary results obtained in experiments devoted to studying the behavior of very thin nickel layers at high temperature (350°C to 450°C) in the presence of hydrogen. The reason for this research is in the possibility, claimed by numerous researchers in Italy and abroad, that in peculiar thermodynamic conditions in the nickel hydrogen system, exoenergetic nuclear phenomena may occur.

The samples used were small silicon chips, in which separated by a dielectric layer, two nickel resistors were constructed. The dimension of such resistors is 3.3 mm in length, 10 microns in width, and 0.1 micron in thickness. One of these two resistors is placed on a SiO_2 layer (inert even at very high temperature), while the other is on a special dielectric layer with high content of hydrogen bonds (10% of Si-H, N-H are present in a PECVD silicon nitride, which means a concentration higher than 1×10^{22} cm^{-3}).

To induce hydrogen absorption, a suitable hermetic stainless steel chamber has been set up in which it is possible to put the sample and reduce the pressure below 10^{-3} torr. Heating the sample at a temperature higher than 350°C, a slow release of H^+ from broken hydrogen bonds in the PECVD silicon nitride is produced (the solid source underneath the nickel resistors). In a few experiments a hydrogen atmosphere is created, filling the chamber with Forming gas (5% H_2 in N_2) and heating the samples.

To heat the cell it is possible to use the polysilicon heater underneath the solid source or the nickel resistors, as shown in the schematic cross section of the cell (Figure 2). During the initial phase of this work, mainly devoted to the comprehension of the material behavior, the short duration of the experiments and the flexibility of the system allowed us to evaluate several boundary conditions.

On the basis of the experimental conditions, it is possible

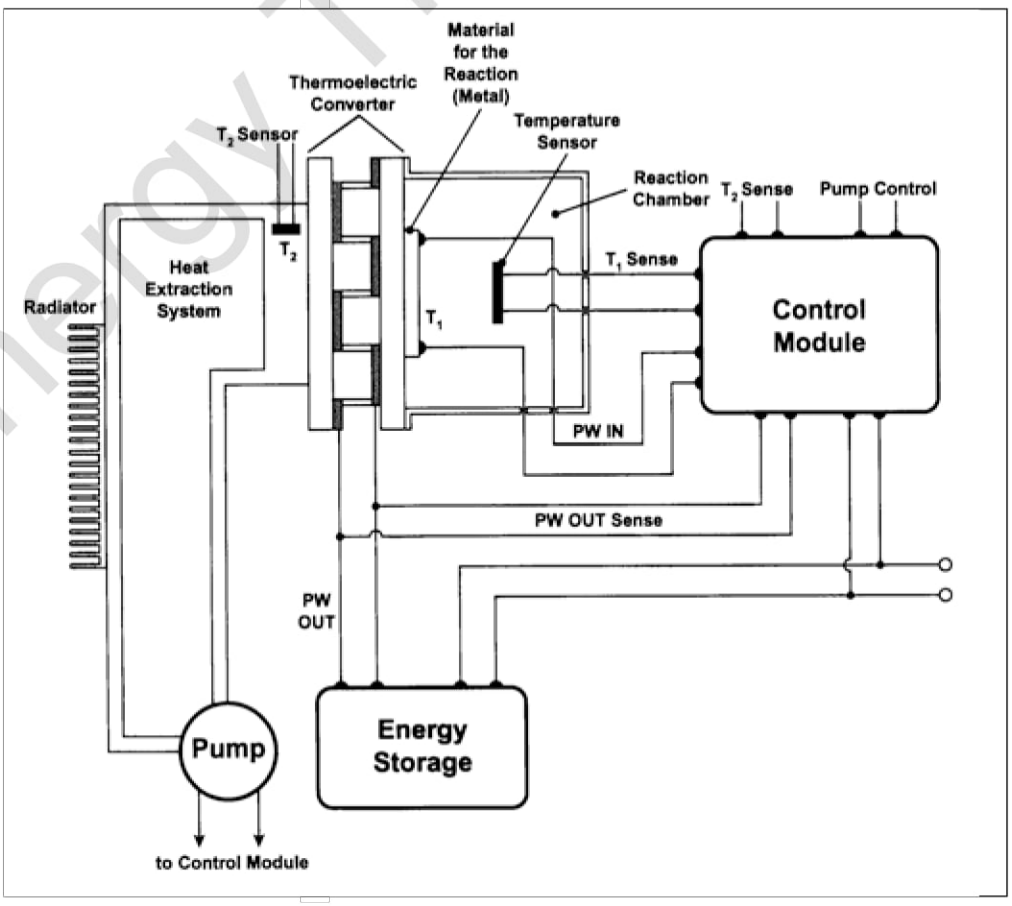

Figure 1. The energy amplifier and other control modules.

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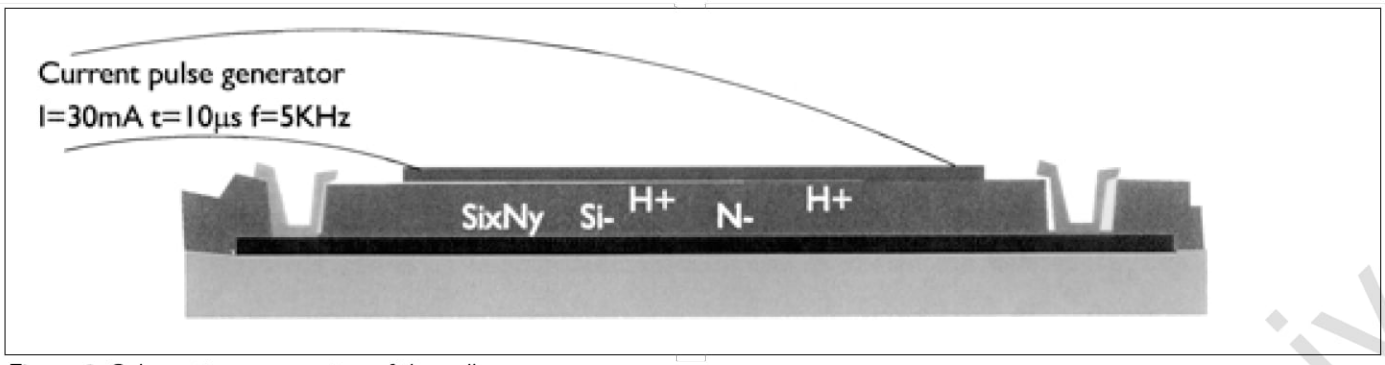

Figure 2. Schematic cross section of the cell.

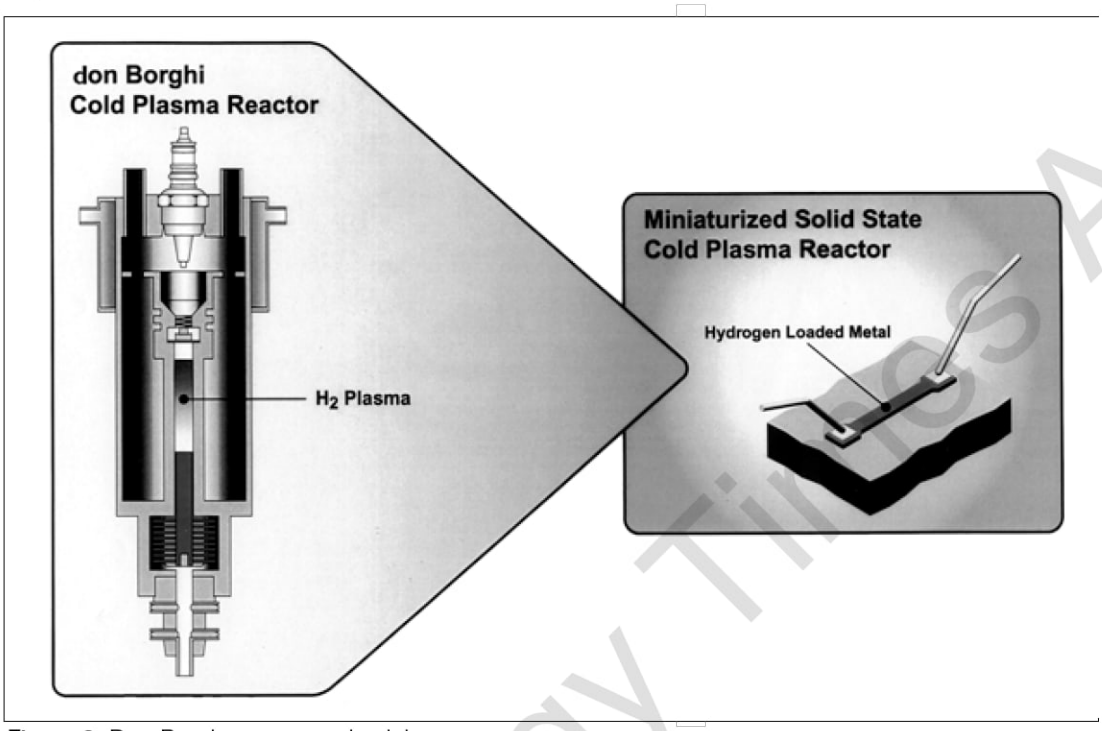

Figure 3. Don Borghi reactor and solid state reactor comparison.

to separate the tests in different groups: a first one with the samples under vacuum and with the hydrogen released by the solid source, a second one with the gas H_2/N_2 in the chamber, a third one in the N_2 environment using the solid source, and a fourth covering the resistors with a solid source layer on top to avoid the nickel oxidation, making the experiments in air under an optical microscope to observe in real time the nickel layer changes. A fifth recent group of experiments has been performed, putting the samples in a SEM chamber and biasing the nickel resistor with high-density current pulses. The use of the SEM chamber allowed us to follow in real time the changes in the nickel layer structure (in two cases a low quality video tape recording was possible).

The main difference between the experiments is in the power needed to heat the samples, because the thermal resistance with vacuum and with the gas differs more than one order of magnitude. So in the case of vacuum the current in the nickel (when used as heater) was three to four times lower than in the case of gaseous atmosphere.

When the polysilicon heater was used, the changes in the nickel layer, produced in a longer time, were more uniform in terms of area involved, but in this case it was not possible to evaluate any energy amplification. However, the hypothesis that is possible to formulate about the observed phenomenology can include these tests as well. It may be useful at this point to remember that all the tests performed can offer us only a qualitative evaluation of the material behavior. This is due to the very small thermal capacitance and very high thermal resistance of the system. These two conditions both imply a strong and fast temperature rise, even if the energy generation spots are random and short.

As mentioned above, the main purpose of the initial phase of this research was a qualitative evaluation of the nickel-hydrogen behavior. So to start a quantitative evaluation phase, some changes are necessary in the system to correct its limitations. The main action is the reduction of the thermal resistance of the system. This may be obtained using larger size nickel samples, directly in contact with a silicon substrate and performing the test in an H_2 gas atmosphere. This change in the system heat sinking also increases the thermal capacitance of the samples, avoiding fast temperature rising in case of excess power production in the nickel layer. Hence, the samples should work long enough to allow a clear quantitative measurement of the amplification and probably of nuclear transmutation in the material.

The don Borghi's Work

The interpretation of the old and new results is based on don Borghi's experimental work. To whomever is not aware of it and its theoretical foundations, due to the difficulties of providing here even a short review, I recommend examining the papers mentioned in the references.[3] However, Figure 3 shows a sketch of don Borghi's experimental apparatus. To be sure, theoretical quantum mechanics can provide objections to the theoretical foundations of don Borghi's work; also consider that it was done around 1940. Nevertheless, it is the opinion of experts in the nuclear field that the experimental results

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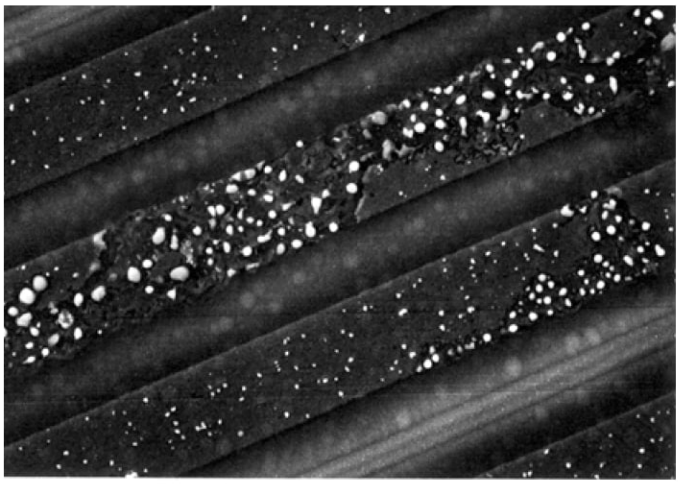

Figure 4. Nickel resistor showing melted areas.

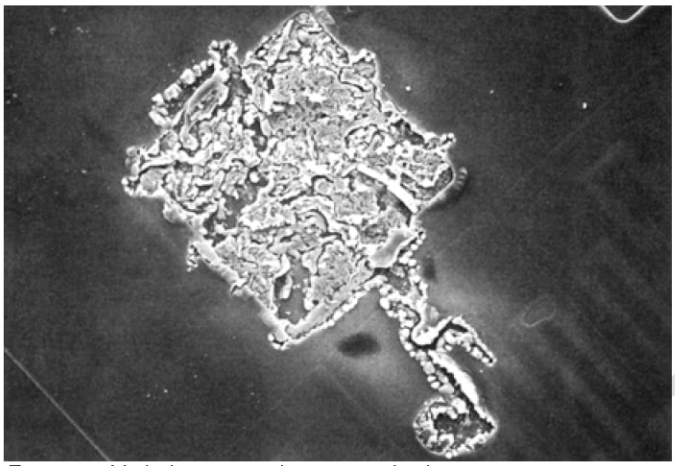

Figure 6. Nickel resistor showing melted area.

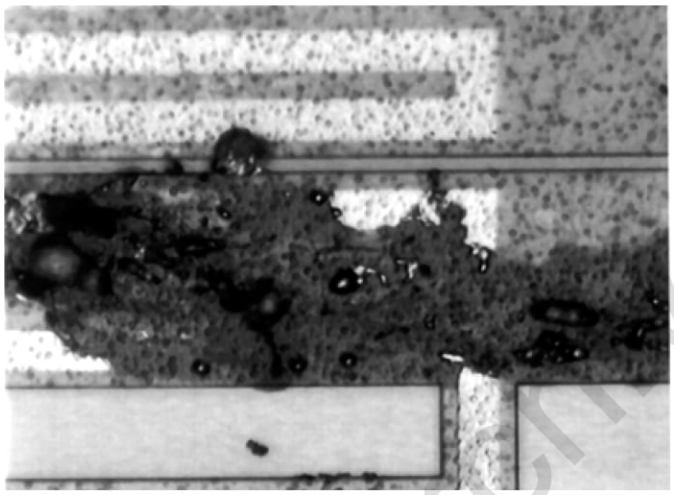

Figure 5. Nickel resistor showing large melted areas.

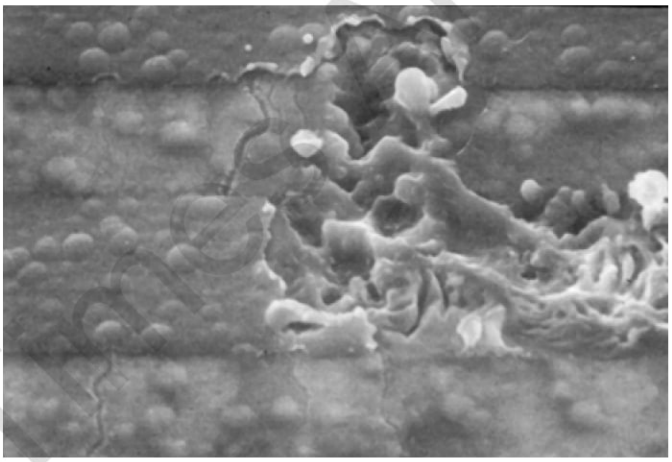

Figure 7. Nickel resistor and underneath material melted.

remain qualitatively incontrovertible.[4,5,6]

Let's now take a look at the analogies between don Borghi's reactor and the structure of the samples we designed to verify the nickel behavior in the presence of hydrogen at high temperature:

1) When, usually at temperatures above 250°C to 300°C, the hydrogen is absorbed in the nickel layer, it is ionized and in the metallic lattice behaves like a plasma. If we imagine 1 cm^3 of nickel with 10^{-3} as <H/Ni> ratio, the plasma pressure is (10^{-3}/6.59) x 22.4 x 10^3 atmospheres (3.4 atm).

2) Using current pulses it is possible to increase the probability of creating neutral particle trough electron-proton interaction, at such low energies to have immediate absorption into nickel nuclei.

In practice, what in don Borghi's reactor was obtained by the RF electric field in the H_2 gas, is automatically produced by the simple absorption in the nickel lattice. Also, the opposed movement of electrons and protons induced by the anodic current is induced simply by biasing the metallic layer endings. Moreover, in the metallic lattice there is a perfect current confinement with the possibility of reaching very high current densities.

Results from Six Different System Configurations (4 and 5 are equivalent)

1) Tests with indirect heating, samples in vacuum, and hydrogen solid source: structure degradation and ohmic resistance increase for the nickel resistor on the solid source and its interruption after few hours of stress (Figure 4).

2) Tests with DC direct heating, samples in vacuum, and hydrogen solid source: degradation (structure and resistance value) for the resistor on top of the solid source and its interruption after a few minutes of stress.

3) Tests with H_2/N_2 3% gas and DC direct heating (Figure 5): sudden interruption of the resistor without any significant change in the structure and resistance value during the stress. The resistor structure shows hot spots with melted nickel both in active and inactive areas.

4) Tests in N_2 gas, solid source for the hydrogen, and DC direct heating: no significant resistance value change and instantaneous resistor melting in large spots when the current density overcomes 2 x 10^6 A/cm^2.

5) Tests done in air with DC/AC direct heating and the nickel resistor interposed between two hydrogen, solid source layers (Figure 6): no significant resistance value variation and instantaneous nickel melting in large spots when the current overcomes 2 x 10^6 A/cm^2.

6) Tests under vacuum, direct heating by high density current pulses (3x10^6 A/cm^2), and hydrogen solid source (Figure 7): no significant resistance value change during a first stress phase (loading), then a relatively quick temperature increase behind 600°C (low amplification phase) followed by an instantaneous melting of large areas of the nickel resistor and poly heater underneath. Table 1 summarizes the test conditions and results.

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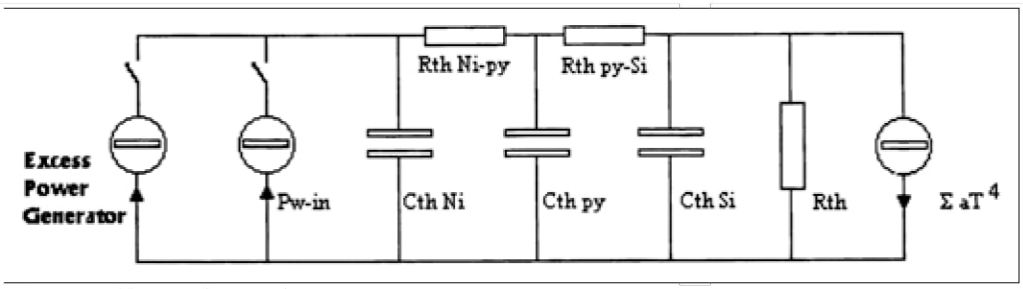

Figure 8. Electrical equivalent circuit.

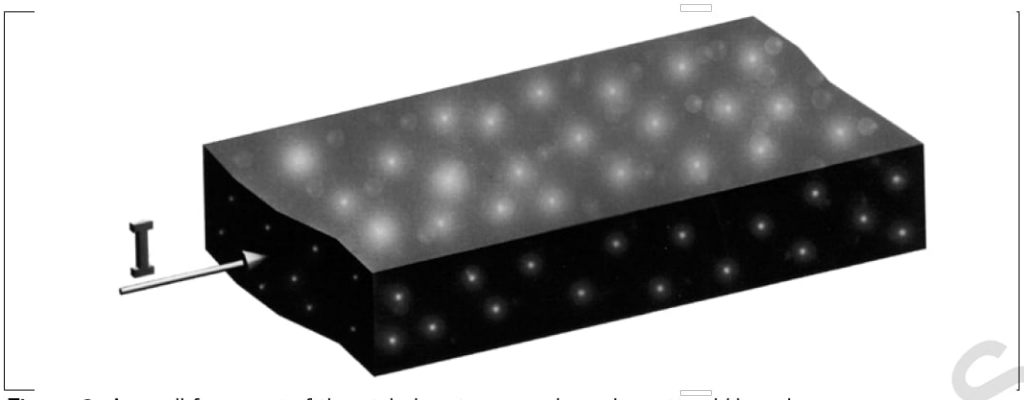

Figure 9. A small fragment of the nickel resistor can be schematized like a box.

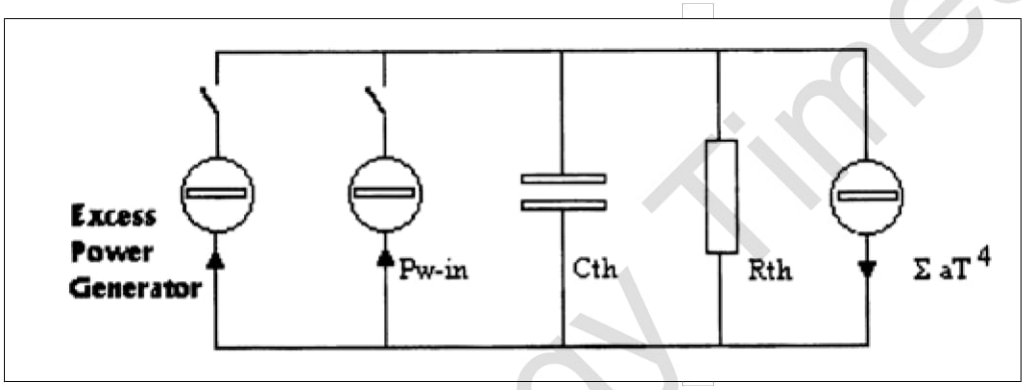

Figure 10. Electrical equivalent circuit for the new samples.

In conclusion, we succeeded in obtaining under vacuum, with low power-in and energy pulses, what we obtained in DC power with a power twenty times higher. The common parameter in the tests giving excess energy is the current density.

The Energy Amplifier Device

What we have described above allowed us to make an approximate evaluation of the amplification factor. It is valuable only in the case of pulsed input power, when the energy is lower than the energy necessary to induce the nickel and also the underneath polysilicon heater melting. In the case of DC power-in, the amplification is not easily valuable because the short duration of the excess energy production (needed to destroy the sample) does not have a corresponding time interval on which to integrate the input power energy calculation.

Excess Energy Generator Model

The thermal behavior of the system can be evaluated using the electrical equivalent circuit showed in Figure 8.

The excess power generator represents the energy per second generated in the nickel layer through the nuclear reaction chains induced by electron-proton interactions. So let's try to arrange on the basis of a very simple classical calculation a qualitative model of the excess energy power generator. A small fragment of the nickel resistor can be schematized like a box as in Figure 9.

The complete sample is 1 cm long, 10 ! m wide, and .1 ! m thick; so in what follows we will refer to these dimensions for modeling the microsystem thermal parameters. Inside the nickel the electron movement gives the current. The interaction we think is based on nuclear chain reactions occurring when the electron-proton distance is less than the "$\mathbf{r_o}$" (2.5 x 10^{-13} cm) value (don Borghi theory). To calculate the number of interactions, we proceed classically.

The charge "**e**" which moves with a speed "v" explores a volume $\boldsymbol{\pi}\ \mathbf{r_o}^2\mathbf{v}$ per second ($\boldsymbol{\sigma}\mathbf{v}$).

The number of electrons pushed by the electric field in the unitary volume is:

$$n = \frac{I}{e} \bullet \frac{\ell}{vV} \qquad (1)$$

Table 1. Summary of test conditions and results.

Heating Method	Sample Environment	Current Density A/cm^2	Hydrogen Source	Power Supply	Amplification
Indirect	Vacuum	0	Solid	DC	~1
Direct	Vacuum	.5 10^6	Solid	DC	~1
Direct	Gas $H_2 + N_2$	2 10^6	Gas	DC	>1
Direct	Air/N_2	2 10^6	Solid	DC/AC	>1
Direct	Vacuum	3 10^6	Solid	Pulse	>10

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where:

$$\frac{I}{e} \qquad (e = 1.6 \cdot 10^{-19} C) \qquad (2)$$

is the number of particles crossing each second the section "**wh**" of the nickel resistor, "**l/v**" is the time necessary to cross the length "**l**" of the sample and "**V**" is the sample volume ("**lhw**").

Hence:

$$n = \frac{I}{e} \bullet \frac{\ell}{v \cdot w \cdot h \cdot \ell} \Rightarrow \frac{J \cdot w \cdot h}{e} \bullet \frac{\ell}{v \cdot w \cdot h \cdot \ell} \Rightarrow \frac{J}{e \cdot v} \qquad (3)$$

(where **J** is the current density).

Multiplying the single particle explored volume by the number of particles per unitary volume, we obtain how many times the unitary volume is explored each second (cm^3/sec).

It is:

$$\frac{J}{e \cdot v} \sigma \, v \Rightarrow \frac{J\sigma}{e} \qquad (4)$$

To know the number of interactions per second we have to multiply the value above by the number of proton targets in the unitary volume; this number is given by the molar concentration ratio <H/Ni> divided by the molar volume (of the nickel if we suppose it is not changing too much after hydrogen absorption), multiplied by Avogadro's number N_a (6.023×10^{23}). (The molar volume is the atomic weight divided by the specific weight 58/8.9.)

So the number of interactions per second and per unitary volume is:

$$\frac{J\sigma}{e} \langle H/Ni \rangle \frac{8.9}{58} N_a \qquad (5)$$

If each event is associated an energy "**Ei**" and the total volume of the sample is "$\mathbf{V_{ol}}$," we obtain a generator with power given by:

$$NEi \Rightarrow \frac{J\sigma}{e} \langle H/Ni \rangle \frac{8.9}{58} N_a V_{ol} Ei \qquad (6)$$

Ei can easily be closed to 1 MeV.

Before going to set the parameters in the equivalent thermal circuit it is necessary to make a hypothesis about how the cross section "σ" may change with the temperature change. If we consider that the temperature changes almost linearly, the electric resistance due to the increased collisions of the electrons with the lattice, in the same way we can consider the "σ" variation versus temperature.[7]

Hence: $\sigma(T) = \sigma_O(1+\alpha\Delta T)$

If, for a given sample, we set:

$$\beta = \frac{Ei}{e} \sigma_o \frac{8.9}{58} N_a V_{ol} \qquad (7)$$

The generator power becomes:

$$P_{Wave}(J, T, \langle H/Ni \rangle) \Rightarrow J\beta(1 + \alpha\Delta T)\langle H/Ni \rangle \qquad (8)$$

For the sample used in most of our experiments ⊠ = 1.8×10^{-4} (Wcm^2A^{-1}). In the case of **Ei** = 1MeV, being **J** in the range of 2 – 4 x 10^6 A/cm^2, even for <H/Ni> around 1/2000 the extra power is more than 1 Watt. This means that, without a suitable duty cycle for the input power switching "**J**," the sample can quickly reach a temperature of more than 1000°C.

Results and Conclusions

The equivalent thermal circuit has been used to simulate the behavior observed during the test in two different conditions and the fitting is very good. In one test an increase of 200°C has been observed driving the input power at 40mW (average value) using 10 ! s pulses and 1 KHz as frequency. The temperature rise is equivalent in our model to an extra power of 244 mW and a <H/Ni> ratio of 9.7×10^{-3}; the power amplification considering only the power input in the nickel (270 mW were supplied to the polysilicon heater) is about 6.

In another test, the input power was all supplied to the nickel using 10 ! s pulses at a frequency of 6 KHz with a current density of about 3×10^6 A/cm^2, corresponding to an average total power of about 500 mW. This second test produced the melting of nickel and of the polysilicon underneath in large spots. A very conservative calculation of the excess power in the melted spots gives a value of $.77 \times 10^{-3}$ for <H/Ni> and a minimum of 3 as energy amplification.

A new energy amplifier has been set up changing the thermal elements that previously gave up the sample destruction at very low amplification levels. The new one is able to dissipate several watts without exceeding 600°C. This condition will allow us to have longer working time amplifying 20 times an input power of few hundreds mW. The proper hydrogen concentration in the nickel will be achieved using a gaseous hydrogen source (pure or diluted).

The thermal equivalent circuit of the new samples to test the energy amplifier is shown in Figure 10.

Acknowledgments

The author is indebted to Dario Galletti for technical assistance in failure analysis of samples and SEM observations of experiments and to Franco Coccetta for technical assistance during recent experiments and for computer simulation of electrical equivalent circuits.

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About the Author

Dr. Ubaldo Mastromatteo received a Ph.D. in solid-state physics from Rome University ("La Sapienza") in 1974. After one year of service in the army, he worked as a teacher until 1976; in the same year he joined STMicroelectronics, at that time SGS-Ates.

In the STM R&D center of Cornaredo (Milan), he spent many years working on silicon processes for manufacturing "Smart Powers," integrated electronic devices for application in dedicated electronic systems in which STM is a worldwide leader.

His main activity is in the field of MEMS (Micro Electro Mechanical Systems), a new emerging technology for integrating mechanical functions on silicon chips.

His interest in cold fusion started in 1994 when hydrogen-rich layers used in microelectronic processes, releasing the hydrogen when heated, caused reliability problems to integrated components. The idea of trapping the hydrogen in thin metallic layers through absorption and confinement using small structures is fully compatible with the technologies used in microelectronics. Since 1994 he has put effort in to investigating the possibility of producing excess heat in solid-state cells fabricated with materials and processes used in microelectronics. He is author of several papers, as well as patents on microelectronics, MEMS, and cold fusion.

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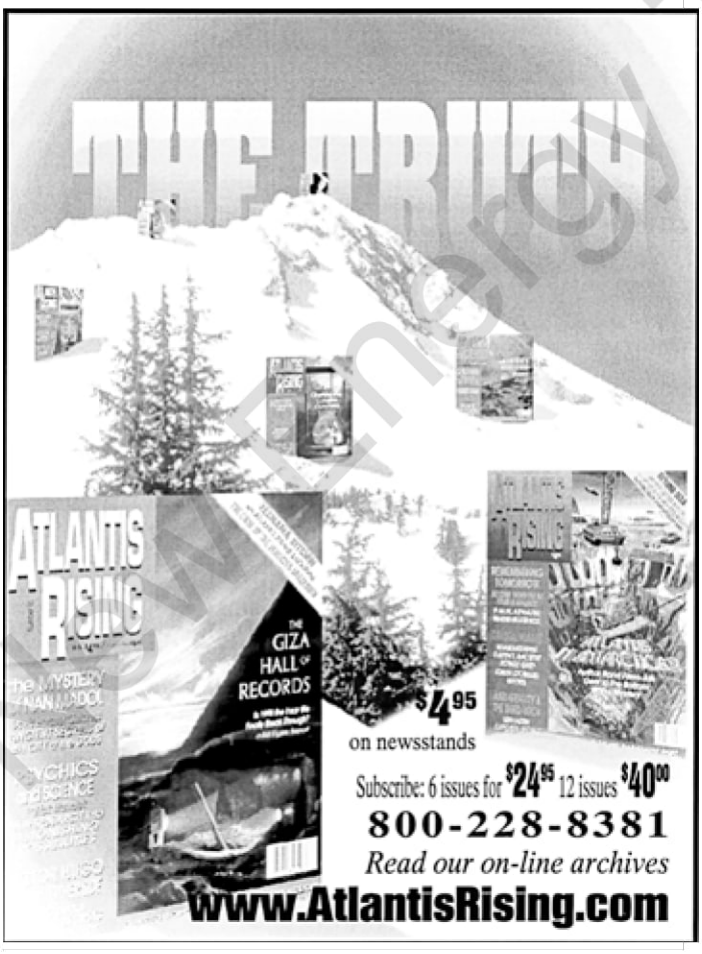

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Description of a Dual Calorimeter

Edmund Storms*

Abstract

A dual calorimeter is described which can be used to study electrolytic processes. Experience with this instrument has revealed several deficiencies inherent in the isoperibolic calorimeter design which apply to all calorimeters of this type when used to study the cold fusion effect.

I. Background

A calorimeter has been designed to measure heat energy produced in a Pons-Fleischmann type electrolytic cell. Two independent methods to determine heat production are used. This redundancy increases the reliability of the results as well as providing a method to study possible errors associated with conventional isoperibolic calorimetry. The design was constrained by the need for a small time constant, the ability to make changes easily, and limited resources. Provisions are made for computer control of the instrument. This is a first generation design, pictures of which can be seen at http://home.netcom.com/~storms2/index.html. A third generation design is presently being used and will be described in future articles.

Unfortunately, the design of the isoperibolic mode is not similar to that used in a stand-alone isoperibolic calorimeter. Normally, the reference temperature outside of the cell is constant and uniform in a stand-alone device. In the dual mode, the reference temperature is variable because the jacket temperature is used as the reference temperature and, in addition, this reference temperature has a gradient between the top and bottom of the jacket. These differences make the isoperibolic mode more unstable than a stand-alone device. Nevertheless, this calorimeter can be used to study several limitations of the general isoperibolic design, limitation which workers in the cold fusion field need to understand.

II. General Description

The calorimeter determines energy production using the temperature change of water flowing through a surrounding jacket and by using the temperature difference across the cell wall. In addition to measuring heating power, the apparatus is capable of measuring the D/Pd ratio, the open-circuit-voltage (OCV), and the overvoltage of the cathode (OV) using two different reference electrodes. Calibration can be achieved by using electrolytic power or an internal heater.

The D/Pd ratio is determined as shown in Figure 1. The amount of unrecombined oxygen produced when deuterium is retained by the cathode is determined from the amount of oil displaced from a reservoir onto a balance (0-600g, ±0.01g). Because the cell contains a recombiner (Pt on carbon cloth), any oxygen not associated with combined deuterium is removed by forming D_2O. Hence, as long as the recombiner is working properly, very little oil is displaced. An additional recombiner is placed external to the calorimeter in the gas line. A temperature change of this recombiner is used to diagnose any failure of the internal recombiner. This device was also used to study the recombination process at the electrodes after the recombination catalysts were removed.

The Pyrex electrolytic cell is surrounded by a jacket through which water flows at a constant rate of 18-27 g/min (±0.2%)[1] with a temperature of 20-50° (±0.02°). Temperature (±0.02°) is measured where the water enters the jacket and where it leaves. A mixing chamber is provided at the exit to insure uniform temperature. Temperature within the cell is measured at three locations. Thermistors are located immediately above the cathode, near the top of the electrolyte, and 2 cm below the top thermistor. A diagram showing the general positioning of the thermistors is shown in Figure 2.

Water flow to the cooling jacket is controlled by two valves, shown in Figure 3. Two operating conditions are used.

1) Thermistor calibration is done with valve A open and valve B closed. This allows cooling water to flow through the jacket at a maximum rate, thereby insuring uniform temperature.

2) Calorimetric measurements are made with valve B open, valve A closed, and the constant-flow pump turned on. This arrangement allows a small fraction of the constant-temperature water flowing through valve B to enter the calorimeter. The rate of flow is measured by filling a container which is weighed by a balance. Upon filling, the container empties back into the constant temperature bath.

An exposed platinum-wire heater is located within the cell to allow Joule heat to be introduced at any time. This wire is also used as one of the reference electrodes when measuring the OCV, as explained in a later section.

The entire assembly is surrounded by an insulated box which is maintained at constant temperature of 20°C (±0.02°). This temperature is referred to as "room temperature" in the text.

All temperatures are measured using linear thermistors (OMEGA 44202). These are calibrated against a mercury thermometer at 20±0.1°C, traceable to the FIST, for absolute measurements. Relative calibration of the thermistors is obtained as follows: The temperature of the water flowing through the jacket and the temperature of the surrounding box are both made equal to 20±0.1°C. Under these conditions, the temperature at all thermistors is assumed to have the same value. The calibration equation of each thermistor is adjusted to reflect this assumption and the temperature coefficient supplied by the manufacturer is used to extrapolate the equations to other temperatures. A temperature increase or decrease of 10° from 20° will introduce an error of -0.05°, based on the coefficients supplied with the thermistors.

The cell voltage (±0.001 V) is measured at the point where the current enters the cell and current (±0.005A) is measured using a known resistor (0.2 ohm). Both values are calibrated using a precision digital multimeter (±0.05%). The power supply is under computer control. Reported voltages are based on an average of 10,000 points and the resulting values are stored automatically using Labview.

III. Calibration Method

Heat Transfer to Surroundings

Calorimeters can not be completely thermally isolated from their environment. Therefore, not only must the tem-

1. This uncertainty is based on using a Fluid Metering, Inc. model RHSY1CKC pump.

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perature of the environment be constant, but this heat leak should be small and well known. The first problem is to determine the heat leak rate.

Heat has two paths for exchanging between the cell and the room. It can pass through the plastic lid and/or it can pass through the vacuum jacket as radiation and gas conduction. It is necessary to determine which of these paths dominates in order that appropriate corrections can be made.

Electrolytic power was applied to the cell using a platinum cathode. The difference between the applied power and the power based on the temperature increase of water flowing through the jacket was determined. When this quantity is negative, the assembly is gaining energy, while a positive value indicates loss of energy. This value was compared to the difference between the room and the average jacket temperature in Figure 4. As can be seen, the correlation between heat loss or gain, and the temperature difference between the jacket and the surroundings, is found to be poor. In other words, heat flow does not change sign when the jacket and the surrounding are at the same temperature, a requirement if heat loss from the jacket through the vacuum space dominates. On the other hand, when a similar comparison is made using the difference between the electrolyte temperature and the surroundings, the correlation is excellent, as shown in Figure 5. Apparently, the heat leak between the electrolyte and the surrounding temperature is mainly through the plastic lid and amounts to 0.13 W/⊠T, where ⊠T is the difference between the environment and the average electrolyte temperature. This heat leak can also be determined by changing the temperature of the environment while keeping the jacket temperature constant with no electrical energy applied to the cell. This approach gives 0.11 W/⊠T.

Calibration of the Flow-type Calorimeter

Fluid passing through the jacket surrounding the cell picks up energy, thereby causing an increase in temperature. The flow rate times the temperature change times the heat capacity gives the rate of energy production within the cell. This method will be called the absolute method in the following discussion. When the absolute method is used, the heat loss correction, as determined above, would have to be applied. On the other hand, when the calorimeter is calibrated by applying known amounts of power, as shown in Figure 6, this heat transfer effect is automatically taken into account. However, such an approach is accurate only when the environmental temperature is constant. For this instrument, the environment is held to ±0.02°. All of the errors combined give a standard deviation of ±0.05 watts based on many calibrations and studies of inert cathodes. Random variations and drift both fall well within this uncertainty.

Calibration can be done either by using power applied between the cathode and anode (electrolytic power) or by passing a current through platinum wire immersed in the electrolyte (Joule power). Good agreement is seen in Figure 6 when power is applied using either method or in combination. Nevertheless, all measurements made during subsequent studies of palladium are based only on a calibration using electrolytic heating. Joule heating is used only to determine whether any drift in calibration has occurred and to change the temperature of the cell independent of applied current.

Because an internal recombiner is used, all chemical energy is retained by the cell. However, if this recombiner should

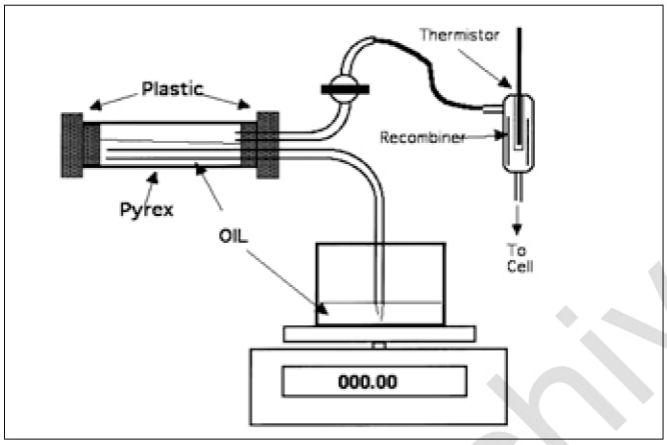

Figure 1. Drawing of a device used to measure the D/Pd ratio of the cathode.

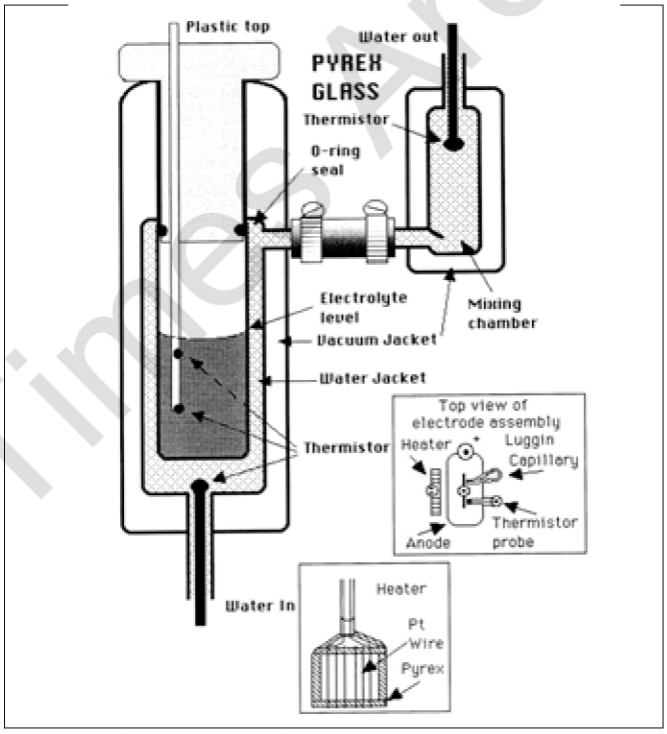

Figure 2. Cross-section of calorimeter.

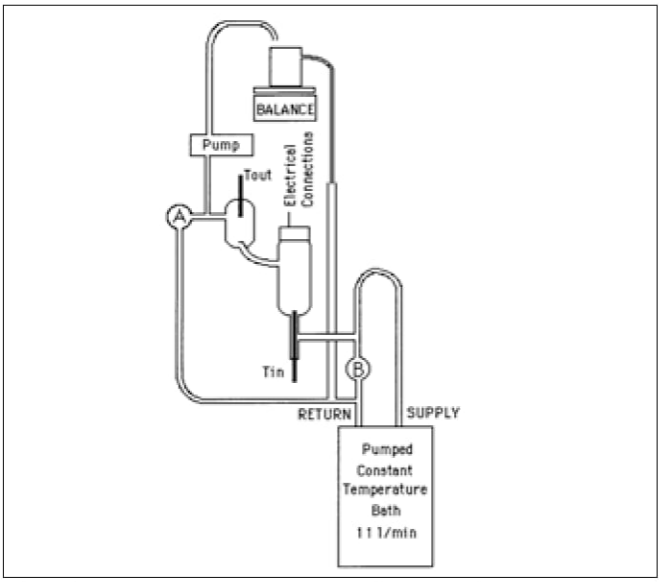

Figure 3. Plumbing diagram for cooling water flow path.

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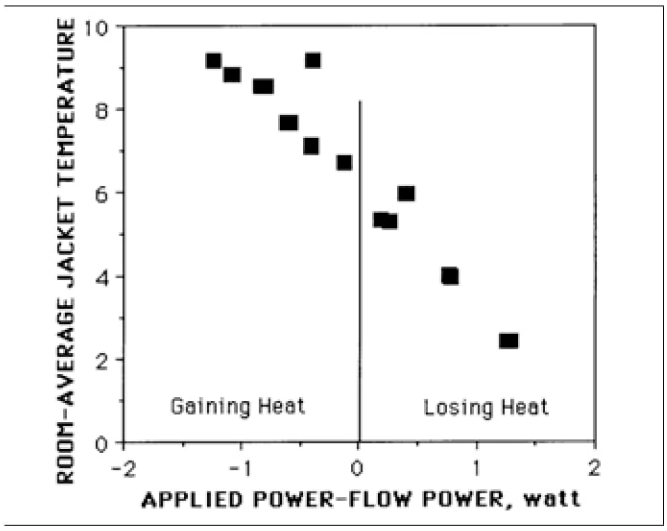

Figure 4. Effect of heat transfer between the jacket and "room temperature."

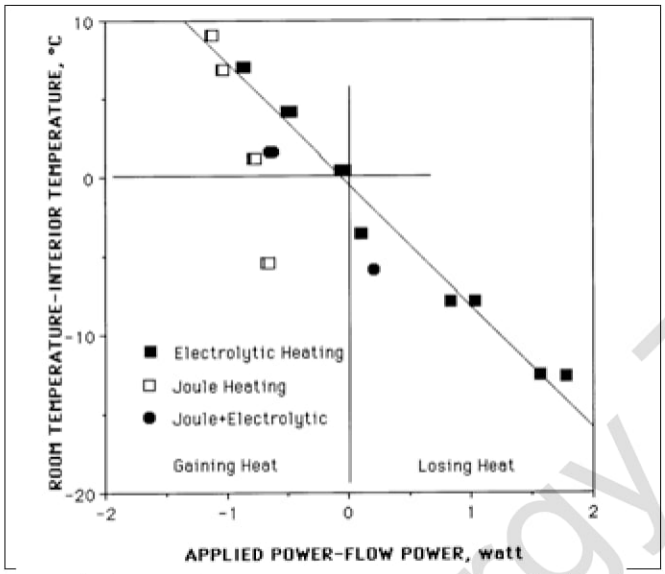

Figure 5. Effect of heat transfer between the cell electrolyte and the surroundings.

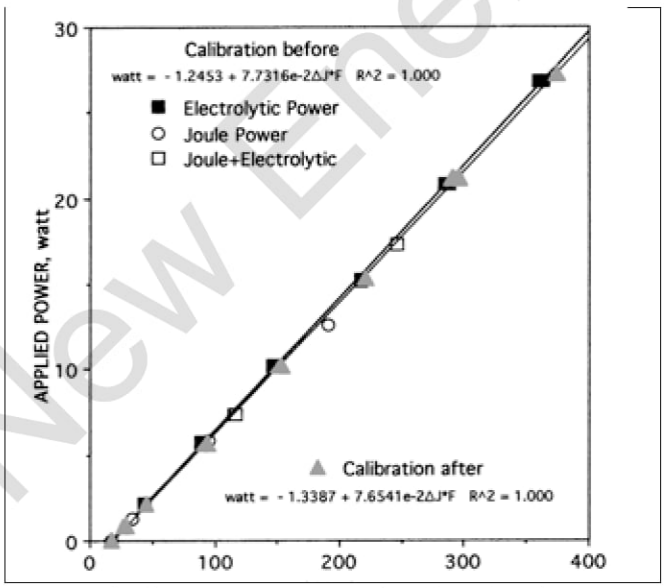

Figure 6. Calibration equation based on flow through jacket.

fail, the measured power could be in error by the amount of chemical energy leaving the cell. To determine whether this error is present, an external recombiner is placed in the gas line where its temperature can be measured, as seen in Figure 1. Thus, any D_2 and O_2 which fail to recombine within the cell will do so in the external recombiner where this process can be recorded as a temperature increase. To calibrate the effectiveness of this system, the cell was electrolyzed after the internal recombiner was removed. As can be seen in Figure 7, as little as 1 mW of chemical power lost from the cell can be detected. In addition, if both recombiners should fail, the loss of oil from the reservoir will be much greater than that produced by changes in the D/Pd ratio, hence easily observed.

Calibration of the Isoperibolic-type Calorimeter

Heat flow out of the electrolyte can also be determined by measuring the average temperature across the glass container. This method relies on knowing the true average temperatures of the cell wall at the inside and outside surfaces as well as the average thermal conductivity of the wall. These requirements can create large uncertainties, as will be described.

Calibration is done by applying known power either as electrolytic current or as Joule heat, as described above. The resulting interior temperature is determined by averaging the temperature at the top and at the bottom of the cell. The average outer temperature is determined by averaging the temperature of the water entering the jacket and that leaving. These temperatures are assumed to represent average conditions at the cell walls. The resulting calibration points are shown in Figure 8 as applied power vs. average ⊠T across the cell wall. A significant difference is seen in this case between the electrolytic and Joule methods. This difference is caused by different temperature gradients being present in the cell. The effect of this gradient is eliminated when some electrolytic power is applied along with Joule power. The magnitude of the temperature gradient between the top and bottom of the cell can be seen in Figure 9 as applied power is increased. The absence of bubbles during Joule heating allows significant gradients to form. However, when some electrolysis is applied along with Joule heating, the gradient is greatly reduced as electrolytic current is increased, as seen in Figure 10. The gradient also changes with time. Figure 11 shows the temperature difference between the top and the bottom of the electrolyte, and the difference between the top and the cathode as a function of time. This behavior is typical and shows that the convection currents are not stable during electrolysis. Even a brief application of increased electrolytic power can shift the convection currents into a different pattern, thereby causing a change in temperature gradient. While these effects are small, they are real and need to be considered.

This time effect is thought to be caused by the following factors: Early in the electrolytic process, bubbles are small and numerous while later they become fewer and bigger. This change is proposed to produce changes in the stirring patterns, hence changes in the gradient. This change also changes the calibration constant, hence the apparent presence of anomalous energy. In addition, changes in the position of the cathodes, as might occur when changing samples, also has a marked effect on this gradient. Production of anomalous energy at the cathode will also change the patterns, thereby adding an uncertainty to the magnitude of the extra energy.

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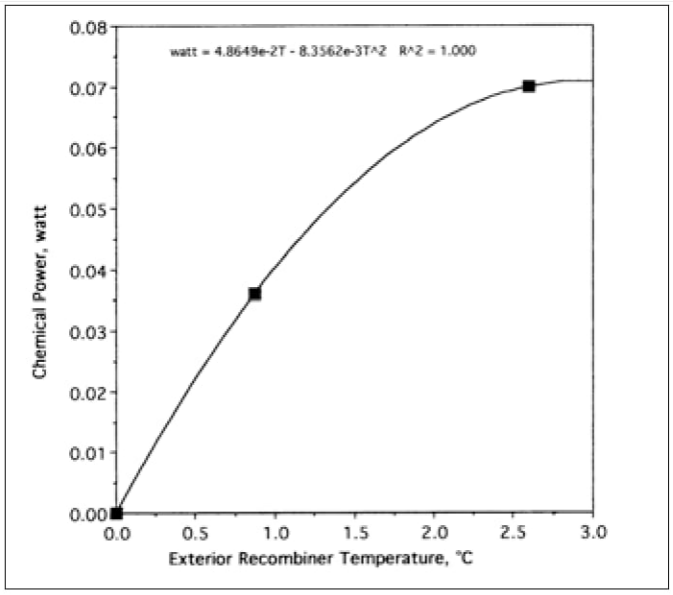

Figure 7. Effect of generated $D_2 + O_2$ gases on the temperature of the external recombiner.

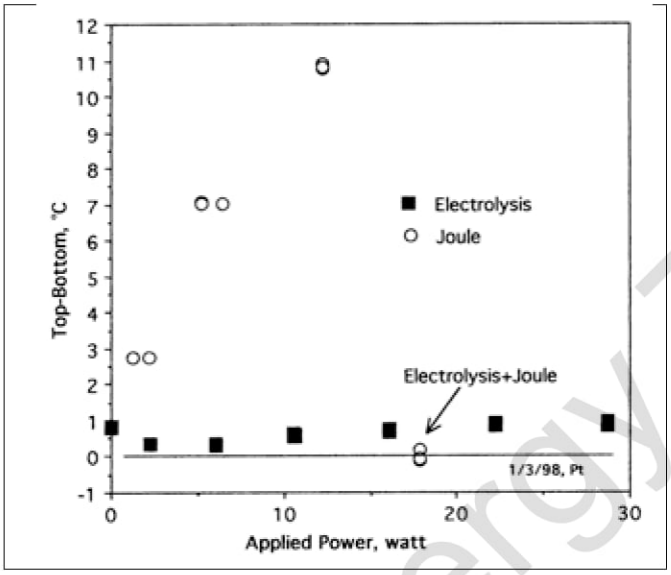

Figure 9. Gradient between the top and bottom of the electrolyte as a function of applied power.

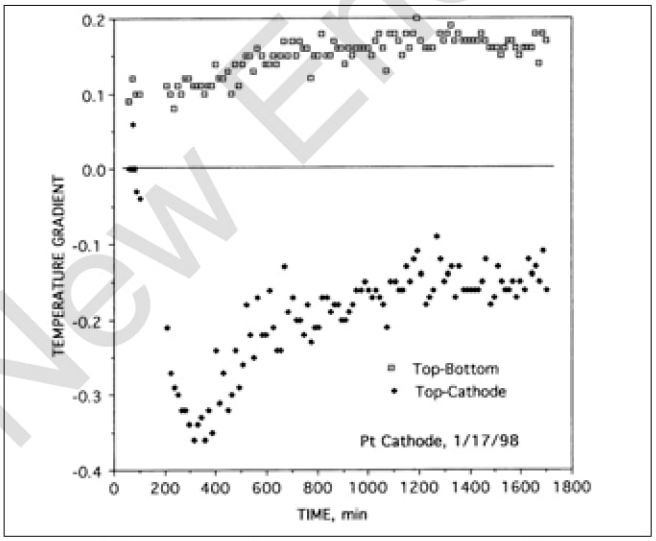

Figure 11. Temperature difference between the top and bottom thermistors, and the difference between the top and cathode thermistors.

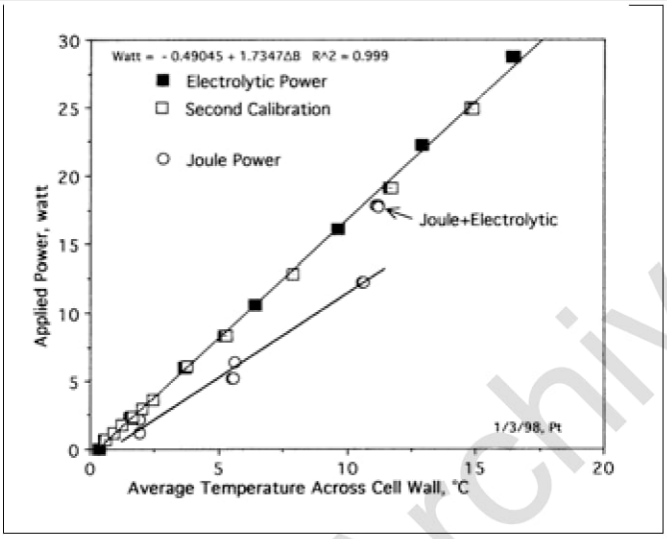

Figure 8. Isoperibolic calibration.

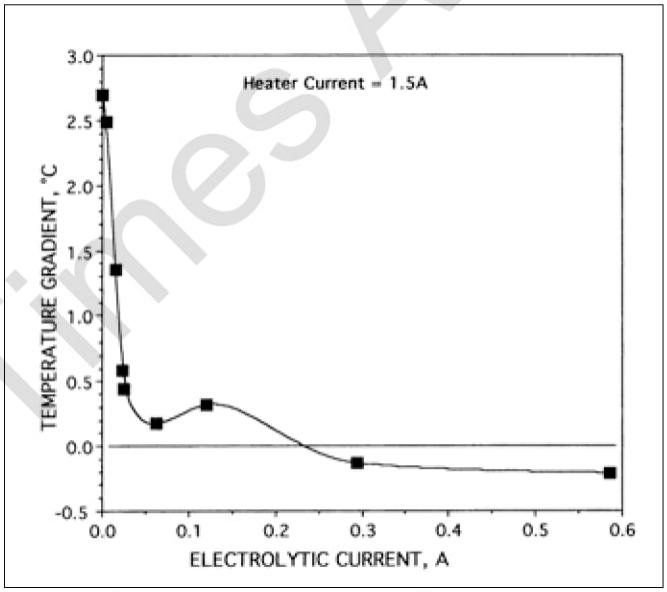

Figure 10. Reduction in gradient as electrolysis current is increased at a fixed heater current.

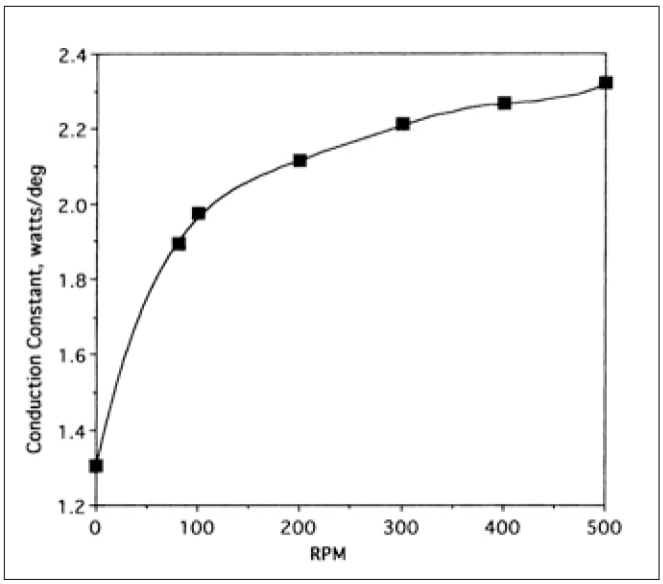

Figure 12. Thermal conduction of cell wall as a function of stirring speed.

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Part of the difference between the isoperibolic calibration constant based on electrolysis and that based on Joule heating can be attributed to reduction of temperature gradient by bubble action. However, this is not the only factor. A stagnate layer of fluid exists at the cell wall and this layer has a variable thermal conductivity depending on the amount of fluid convention. This variable was explored using a similar cell which could be stirred by rotating a magnetic bar with known rotational speed. The slope of applied power vs. temperature difference across the cell wall was determined at various rotational speeds. The resulting values for the thermal conductivity of the cell wall are plotted in Figure 12 as a function of rotational speed. This increase takes place even when the temperature gradient within the cell becomes very small, as can be seen in Figure 13. Clearly, the effect is not influenced by gross temperature gradients within the cell. However, at low stirring rates or when only a small number of bubbles are being produced in the absence of mechanical stirring, the combined effect of gradient and stagnate layer can have a dramatic effect on the calibration constant. Even when high currents are applied or mechanical stirring is used, unpredictable behavior will be observed. In addition, growth of films on the glass surfaces caused by bacteria action or impurity deposition can further change the effective thermal conductivity during long duration studies.

The total uncertainty in this method of heat detection is ±0.5 W using the design described in this paper. Most of the uncertainty is caused by drift in the calibration constant caused by changes in bubble pattern and changes in the effective thermal conductivity of the glass wall. However, the short-term random error is much less, being about ±0.05 W.

Mechanically stirred cells used previously by the author show a much smaller total uncertainty. Use of the double-wall isoperibolic method would eliminate these problems completely.

IV. Open-Circuit-Voltage

The voltage measured between the cathode and a reference electrode is proportional to the log of the chemical activity of hydrogen at the cathode surface. It also provides a way to determine the effective pressure of D_2 gas within voids, as shown in Figure 14.

This voltage can be determined when the current is briefly stopped, and is called open-circuit-voltage (OCV). The voltage is called the overvoltage (OV) when it is measured while current is flowing. The latter situation is complex because the voltage is influenced by the IR effect produced in the electrolyte by the flowing current and by the voltage drop across any barrier at the cathode surface. Both voltages are measured using two methods. The value called "in" (Figure 15) is obtained using an external platinum electrode which samples the voltage at a small spot on the cathode through a Luggin capillary placed within 1 mm of the surface. The value called "out" is obtained using a platinum wire (heater wire) immersed in the electrolyte outside of the cathode-anode structure. The latter method gives an average value for the entire cathode surface. Both reference electrodes are calibrated by comparing them to a clean platinum cathode. Figure 15 shows the change in OCV for a platinum cathode after being electrolyzed at 2 A. Once the applied current is turned off, the OCV voltage drops quickly as deuterium is lost from the metal surface. The "out" electrode shows the expected zero voltage after all deuterium is lost. However, the "in" electrode appears to have a -0.04 V bias which is evident

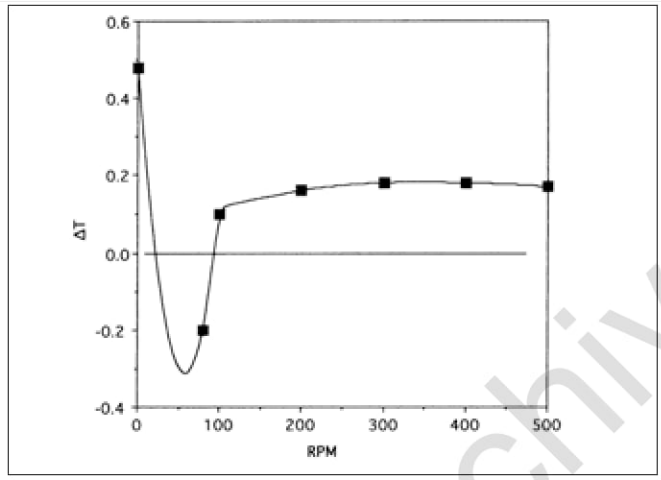

Figure 13. Temperature gradient between the top and bottom of the cell as a function of stirring speed.

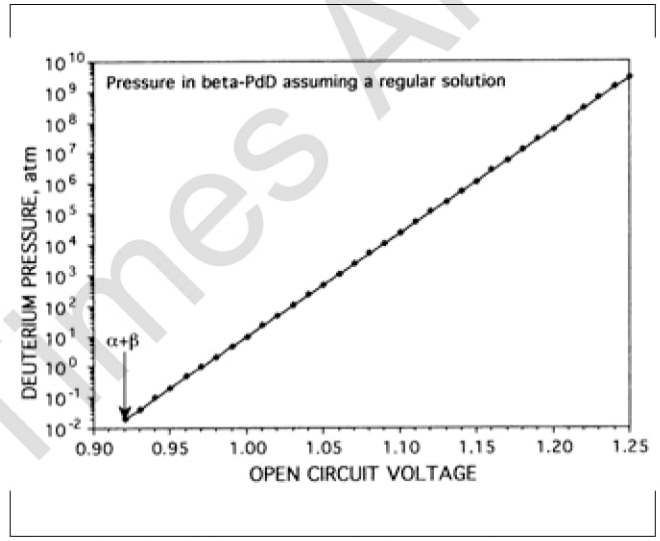

Figure 14. The OCV is measured relative to platinum exposed to the same electrolyte as the cathode. The effective pressure is calculated using the published thermodynamic properties of β-PdD and the Nernst equation.

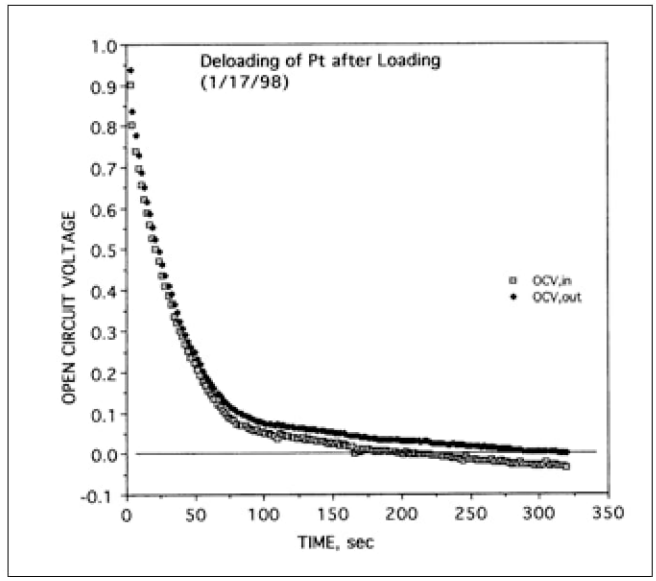

Figure 15. Open-Circuit-Voltage (OCV) of Pt as a function of time after a current of 2.0 A is interrupted.

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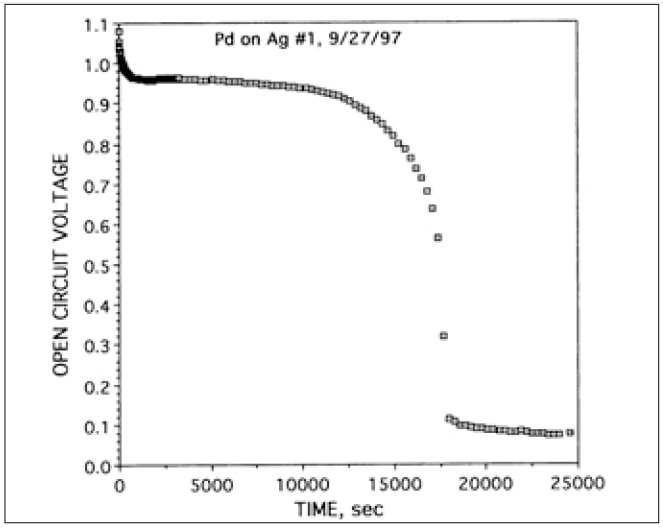

Figure 16. Open circuit voltage during deloading of Pd plated on silver.

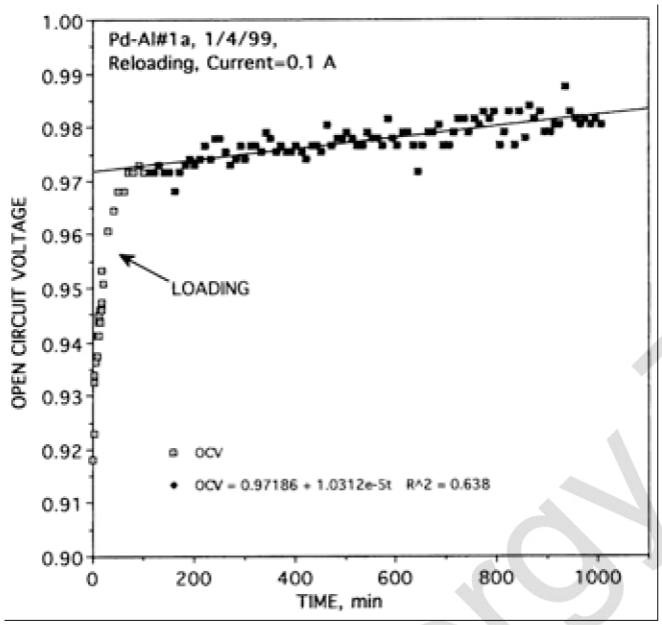

Figure 17. Behavior of the open circuit voltage during and after loading.

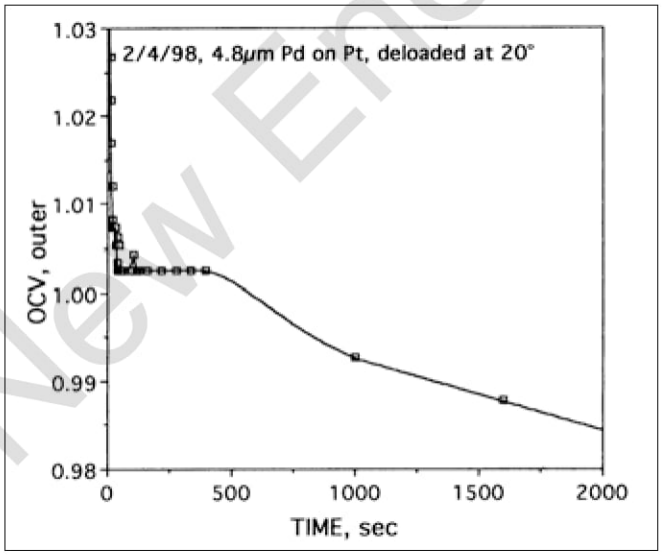

Figure 18. OCV as a function of time after current of 0.05 A was stopped.

both at the beginning and ending of the study. This bias is caused by small drifts in the reference electrode potential for which a correction needs to be applied if absolute values are required. However, useful information can be obtained using only relative values. This approach is in contrast to using a reference electrode held at a fixed hydrogen pressure of 1 atm, called a SHE (Standard Hydrogen Electrode), which can give absolute values for the voltage. However, the latter method is too complex to be useful in this application.

Deloading of palladium has a much different behavior. A thin coating of Pd on silver produces the behavior during deloading, shown in Figure 16. A very rapid drop is seen until the composition of the surface enters the α+β region, after which the OCV becomes relatively constant. Another rapid drop is seen after the β–phase has been completely converted to α-PdD. A reverse of this behavior is seen during loading. In addition, once the sample is mostly fully loaded, the OCV slowly rises as electrolysis is continued, as can be seen in Figure 17. A similar deloading behavior is seen in Figure 18, which shows the behavior of 4.8 μm Pd on Pt. In this case, the OCV drops very rapidly at first then shows a plateau for a brief time. Further deuterium loss causes a slow drop toward a value expected for the α–β mixture. The time during which the surface is a two-phase mixture during deloading is proportional to the amount of Pd present. Presence of a second plateau above the α+β region is characteristic of samples which produced excess energy, as was the case for this sample. Consequently, the shape of such curves gives important insight into the nature of the palladium surface and the eventual production of excess energy.

Because of the very rapid loss of deuterium from thin films, provisions are made to keep the delay time in measuring the OCV after current is turned off to between 0.1 and 0.5 sec. Nevertheless, significant deloading can occur during this time when the layer is very thin. In addition, regular measurements are made of the overvoltage, *i.e.* the voltage generated while current is flowing. Figure 19 shows the typical behavior of a fully loaded sample. The OV moves in concert with the OCV, but not always by the same amount.

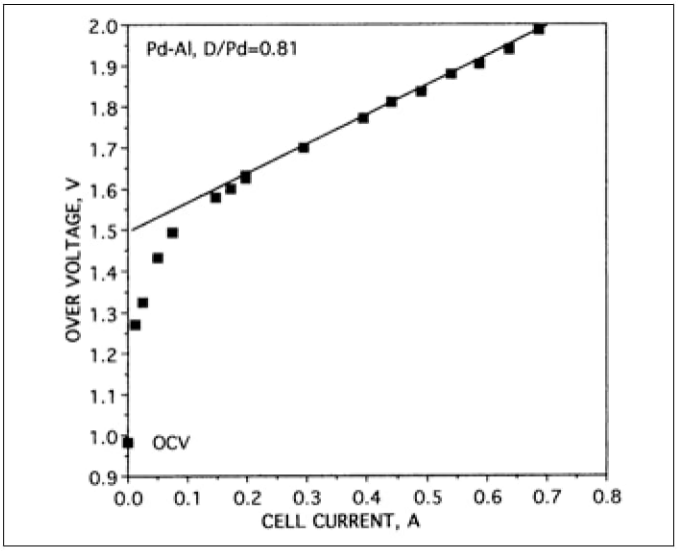

Figure 19. Typical behavior of the overvoltage as current is changed. The single value for open-circuit-voltage was obtained while the current was interrupted for 0.1 sec. Values are referenced to an external Pt electrode using a Luggin capillary. The line shows the effect of the voltage drop within the electrolyte produced by the flowing current.

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Conclusions

1) Temperature gradients within the electrolyte are reduced by bubble stirring. The remaining gradient is variable, hence can change with time and with the position of the cathode with respect to the temperature sensors. However, a "normal" isoperibolic calorimeter will show a much smaller effect than detected in this study. Consequently, this error is not significant when evaluating such studies.

2) An unstirred, isoperibolic calorimeter cannot be calibrated using an internal heater but must be calibrated using heat generated by electrolysis. Many workers use heater calibration while electrolytic current is flowing. This method greatly reduces the potential error associated with heater calibration alone. However, use of sufficient electrolytic current to eliminate the gradients must be demonstrated.

3) A major source of error when using an isoperibolic calorimeter is caused by the stagnate layer of fluid on the cell wall. This layer changes the thermal conductivity of the cell wall in unpredictable ways, and is not removed by bubble mixing or by stirring. The layer is unstable with respect to time and is very sensitive to convention currents produced by bubbles. Cells using small currents are especially sensitive to errors produced by this effect. The isoperibolic method is also susceptible to significant drifting of the calibration constant caused by changes in stirring pattern. A single-wall isoperibolic calorimeter which loses most of its heat by radiation will not be affected by this problem.

4) The OCV is a sensitive method for investigating composition and phase changes at the cathode surface. However, the value can be lowered because of hydrogen loss during the measurement. In addition, this loss during such a measurement can prevent the surface from achieving the necessary high composition to achieve the CANR effect. Therefore, the technique needs to be used with caution.

5) Although a flow-type calorimeter is not sensitive to temperature gradients within the cell, it does suffer from other errors which need to be revealed by appropriate calibration. For example, heat exchange through the lid can affect the results even though the rest of the cell is held at a constant temperature.

About the Author

Edmund Storms, Ph.D. in radiochemistry, is retired from Los Alamos National Laboratory. He presently lives in Santa Fe, where he is investigating the "cold fusion" effect in his own laboratory. A complete biography can be found in IE No. 32.

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The man with a new idea is a crank, until the new idea succeeds.

Mark Twain

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Dark Matter and Cold Fusion

Joseph L. McKibben*

The author is proposing four dark-matter particles. They are built out of subquarks, positive hemitrons, and also negative hemitrons. This author now suspects these are the most abundant particles in the cosmos and that means they outnumber the nucleons by a sizeable factor, yet we are unaware of their existence.

I published a paper in an early issue of *Infinite Energy*[1] using data taken in 1967 by an experimental group[2] at the Argonne Laboratory. My paper had almost zero impact. This was unfortunate, I believe, because there is very important information in this paper. It was that data that led me to believe in the existence of *subquarks* and *positive hemitrons* that are described in the next two paragraphs.

It seems plausible that there are only two unknown basic particles in the Argonne data and these particles came from dark matter. I now suspect that there is a significant amount of dark matter in and around the Earth. Its nature will be described later in this paper. The prominent component particle observed in the data was called *subquark* in my paper in *Infinite Energy*. Its mass was measured to be ≈ 1.15 amu, electrical charge to be +e/6, and it presumably had the standard color charges which are red, green, and blue. While in its dark-matter nucleus, if it is struck by another particle at moderately high velocity, or even exposed to high temperature, then it becomes free. The subquark is now free to make many collisions that can catalyze the union of a pair of nuclei, since its strong attraction to particles is larger than the coulomb repulsion that exists between them. Eventually, it makes a collision with a nucleus that results in it becoming attached to it. The binding energy to a nucleus was observed to be 15 MeV per nucleon in the nucleus, so it is quite high. Because of its low charge, collisions resulting in sufficient energy loss to result in capture are infrequent; however, they do seem to occur. This low capture rate does make the subquark an excellent catalyst. Eventually this subquark with its captured nucleus encounters another subquark with a different color charge and bound to it is an identical nucleus and, so, they unite. Finally, the pair finds a third subquark with complimentary color charge and an identical nucleus and they also unite. Their net electrical charge is then +e/2. Their net color charge is near zero because of their 120° phase relation.

Observed in the data was a second fundamental component particle called *hemitron*. It had a mass of ≈ 0.13 amu and a charge of +e/2. I speculated that such a particle with charge –e/2 also had to exist; however, the name hemitron was chosen even though we have to specify the sign of charge when referring to them. No negative hemitrons showed up in this data; however, in the discussion of dark matter below they are a very important particle. The triad of subquarks and their attached nuclei were surrounded by three positive hemitrons. My suspicion is that the hemitrons have anticolor charge but have no proof. If the attached nuclei are helium, then the composite particle has the chemistry of oxygen. Mass-over-charge peaks of several different elements were observed. I was fortunate to be able to identify the many peaks.

These particles were found in fused quartz. Quartz has high diffusivity and that greatly helps the components find their counterparts. Fused quartz has a high glass blowing temperature that allows the formation of fractionally charged ions due to a plus hemitron leaving the complex particle assembly. These ions can then be readily removed from a fused quartz cylinder at ≈ 800°C temperature especially if an electric field exists across its wall. And then the –e/2 complex ion can be identified in a mass spectrograph.

If the particle attached to each subquark has one more neutron than protons, an example is Be^{9}, which forms a nucleus resembling silicon, then after an extended period of time two subquarks join together with their attached nuclei, but the two extra neutrons leave the assembly. Now instead of having silicon we have a nucleus resembling fluorine, but with an extra charge of +e/3. This ion has very high affinity for an electron, so it is always observed with charge -2e/3. This was by far the most abundant ion observed in the 1967 experiment. The subquarks observed were likely lightly attached to these ions and were released when fused quartz was heated to glass-blowing temperatures.

Dark Matter

Recently astronomers and cosmologists have been discussing dark matter, for they have put a great deal of effort in studying it. They believe it is there because it greatly increases the velocities of stars in galaxies. There are ≈ 125 billion galaxies and they now claim they can see back in space ≈ 13 billion light years. So the cosmos is filled with an incredible amount of mass. But they now estimate the dark mass as being nine times larger. Cosmologists have been studying many different particles that may fill that role. First it was neutrinos, but they went on to axions, WIMPS (Weakly Interacting Massive Particles), black holes, etc. I believe the following particles need to be added to their list of candidates.

Figure 1 resembles a cartoon, because I really do not know how to represent the particles. The subquarks were drawn large not because they are physically large, but because they are more massive. The +e/6 piece of a positron is shown as a tiny dot in its center but it is likely spread out in the spin-zero particle. It would be nice if Figure 1 could be shown in color, for a hemitron close to a subquark should be shown in anti-color, I suspect. The -e/2 piece of electron is shown as a circle rather than a black circular dot.

Let us call the particle shown in the drawing quasi-proton, as its net charge is +e. Convert a plus hemitron to a minus hemitron and we have a quasi-neutron. Convert the other plus hemitron to minus hemitron and we have a quasi-negatron. I have had to invent a name for this negatively charged particle. Now if these three quasi-particles are united by a force, then we have a dark matter particle, since its net charge is zero and it has no electronic charges circling around it and therefore cannot reflect light. They are likely abundant in the Earth—we do not know about them since they do not interact with our atoms.

If a quasi-particle has all three +e/2 charged hemitrons present, it has a net charge of +2e and so it is quasi-helium. However, it needs to have two electrons or be joined by two

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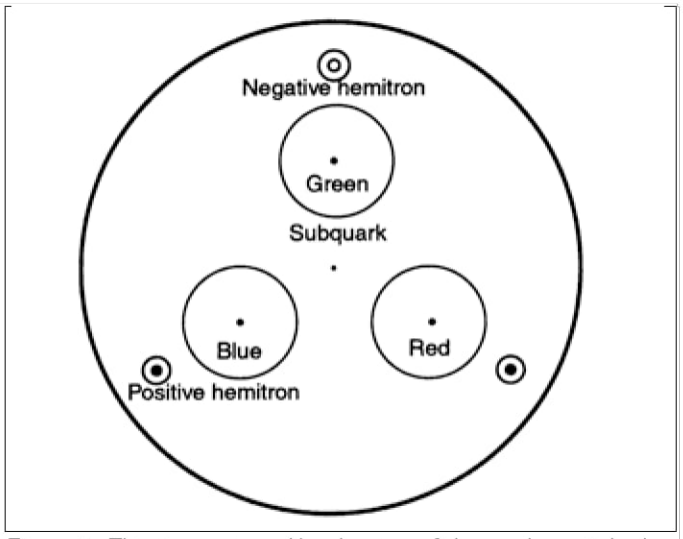

Figure 1. This is a cartoon-like drawing of the crude particle that resembles a proton.

quasi-negatrons. The latter seems unlikely and it does seem to be observed, so I am unable to guess what actually might happen to them.

Since the Sun is exposed to all of these particles, it should have cold fusion present in it too. Since the neutrinos observed coming from it are significantly less than one half the number that should be present if all reactions were due to hot fusion, cold fusion may well be larger in magnitude in it than hot fusion. This possibility has been discussed in recent issues of *Infinite Energy*.

Maybe somebody will collect subquarks and measure its properties. It looks suspiciously as though a man named John Keely, who was sonically collecting this triple quasi-particle with his musical chords well over one hundred years ago! But that is another story.

After writing the above, I read in the latest *Science News*3 a three-page article concerning the latest findings in regard to expansion of the cosmos. I am quoting one paragraph that seems to be particularly related to the findings of this paper. "Cosmologists have come to attribute the acceleration to an unusual form of energy that distributes itself uniformly throughout the cosmos rather than breaking into galaxies, galaxy clusters, superclusters, or other clumps. At present, this energy has a higher (average) density than matter, and its gravitation influence dominates the cosmos." Could this quotation describe the nature of this energy?

John Schiffer and his group at the Argonne Laboratory, after observing the mass/charge peaks during 1967 corresponding to these particles, obviously could not believe they were observing the most numerous particles in the cosmos. The cold fusion experts ignored my suggestion that the subquarks were the particles that were catalyzing cold fusion. I would like to see a tandem electrostatic accelerator put to work studying the subquarks and positive hemitrons. They both were observed to form negative ions by electrons being attached and so will be converted into positive ions in the terminal of a tandem. Their net energy would only be the terminal potential times the charge of an electron. Fortunately, a unit with a large terminal potential is still in operation at Yale University. Unfortunately, finding and accelerating the negative hemitrons will be very difficult unless somebody finds a simple solution.

After writing the above I came across a paper by Daniel P. Schrag[4] at Harvard University who is in the Laboratory for Geochemical Oceanography. He published a chart showing the time scale of the Ice Ages during the last half million years. There is good indication of a glaciating period occurring every 100,000 years with a warm period in between. This observation suggests that we are passing through dark-matter particles periodically, which heats up the sun and melts the glaciers. Of course, Schrag's paper concerns the orbit and axis orientation of our Earth—this investigation has been under way for many years. Still another informative article[5] has appeared in the most recent issue of *Science*.

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About the Author

Joseph McKibben was born on a farm in central Missouri on October 22, 1912. He graduated from college in 1933 and received a Ph.D. He spent the next two years on two farms, where he became fascinated with the ether concept of matter. He was hired as a teaching assistant in the fall of 1935 at the University of Wisconsin.

Starting in 1937, McKibben helped Ray Herb develop the pressurized electrostatic accelerator by building a second one with help. They performed developmental tests on it. Mr. Herb went to the Radar Lab in the fall of 1940 and McKibben, with the two Wisconsin accelerators, went to Los Alamos, New Mexico in April 1943.

Dr. McKibben was asked to generate the timing signals for testing the first atomic bomb. After the war he directed the building of a large electrostatic accelerator at Los Alamos. Then in 1955 he took the lead in designing and building a source of polarized H^- and D^- ions. He operated it until he retired from Los Alamos in April 1980. His retirement project has been studying his ether theory. While doing that he came across experimental evidence for the existence of subquarks and positive hemitrons.
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The discovery of the steam-engine owed its birth, like most human inventions, to rude attempts which have been attributed to different persons, while the real author is not certainly known. The important discovery is not the first attempt but the successive improvements.

Sadi Carnot, "Reflections on the Motive Power of Heat," Introduction, 1824

New Energy Times Archive

BRIEFS...

Compiled by Eugene Mallove

Fissioning Electrons? Have "Electrinos" Been Discovered?

In September, physics and science journals were electrified by published research from Brown University British physicist Humphrey Maris (Brown University/Ecole Normal Superieure, maris@holley.physics.brown.edu, 401-863-2185), which claims that electrons can fission—split into two or more pieces. This would radically contradict a fundamental pillar of quantum mechanics, which recognizes no such possibility.

In quantum mechanics, the electron is indivisible. Numerous establishment physicists reacting to Maris' research in the various news accounts are firm: Maris is most likely not correct, because if he were, quantum mechanics would be dealt a profound body blow. There is nothing more fearsome in all Physics Land than a radical threat necessitating a major revision of quantum mechanics! Here is the delicious part: no flaw has yet been found in Maris' analysis of the experiments on which his claims are based.

Maris' article in the *Journal of Low Temperature Physics*, Volume 120, Nos. 3/4, August 1, 2000, published by Kluwer Academic/Plenum is titled: "On the Fission of Elementary Particles and the Evidence for Fractional Electrons in Liquid Helium." The physicist's contention is that many years of puzzling results from experiments with liquid helium could be explained by fractional electrons. Maris presented a paper on this work in June at a conference on quantum fluids and solids. No definitive rebuttal from the bastions of quantum mechanics experts seems to have been forthcoming.

When an electron is injected into liquid helium, a very small bubble (about 40 angstroms diameter) can form around it. Light illuminating the bubble should cause the electron to fly out of the liquid helium, yet no such electrons were detected, and certain other still-unidentified charged particles were detected. (The light employed may be from a carbon dioxide laser with a wavelength of about 10 microns.) Maris explains the possible new particles as "electrinos," fragments of a fissioned electron. He proposes that when oscillating bubbles themselves split up, they fission the quantum mechanical electron wave and cause the new particles—electrinos—to form. Many physicists, though excited by the claims, think a more mundane explanation may be in order and are awaiting more definitive experiments.

Maris, reviewing other evidence by researchers at the University of Michigan done in 1971 and at the University of Lancaster (UK) in 1984 in which the electrons injected into the helium were created in an electrical discharge, also found anomalies. Maris says these can be best explained by his electrino theory, electrinos with half and quarter charges. Is it possible that electrinos may help to explain phenomena in various new energy devices involving electrical discharge or bubbles, including cold fusion systems?

Cold fusion follower Akira Kawasaki looked into what the ivy league Brown University (in Rhode Island) website has to say about Maris, and reported this: "He has done research in various parts of the world, including University of Tokyo and Hokkaido (a 'hot bed' of cold fusion research). There is an earlier article published which seems related to the latest: 'Observation of Exploding Electron Bubbles in Liquid Helium,' (with J. Classen, and C.K. Su), *Phys. Rev. Lett.* 77, 2006 (1996). His research interests: Low temperature physics, magnetic levitation, neutrinos, nucleation, picosecond optics, ultrasonics and phonon physics."

A *New Scientist* article by Marcus Chown (October 14, 2000) quotes Maris: "Electron fragments behave to all intents and purposes like entirely separate particles." Nobel laureate Philip Anderson, Princeton University's nemesis of new physics ideas (such as cold fusion), thinks that ". . .Maris must be wrong. 'But it is not obvious why,' he admits," according to *New Scientist*. Maris is quoted in summary: "What I have come up with is an intriguing puzzle. . . I want people to think. I would be happy if I was completely wrong, but made a lot of people think."

Antigravity Claims in the News

In *Infinite Energy* No. 9 (July/August 1996, p. 49), the late Chris Tinsley discussed claims of up to 2% weight reduction "anti-gravity" or "gravity shielding" effects observed over a rotating high temperature superconductor. These claims had been made in published work by Eugene Podkletnov *et al.* of Tampere University in Finland. Periodically, these claims have resurfaced and have been discussed in various electronic forums and in publications. It has been known for some time that NASA scientists have been hard at work trying to verify the Podkletnov claims. In 1997 Charles Platt in *Wired* (March 1998, Vol. 6, "Breaking the Law of Gravity," p. 170) magazine wrote a fine piece about the Podkletnov work and replication attempts.

Jim Wilson has a two-page update, "Taming Gravity," in the October 2000 *Popular Mechanics*. He reports that earlier this year, BAE Systems, a large British aerospace company had initiated its own search for the anti-gravity effect in its "Project Greenglow." *Fortean Times* (No. 135, July 2000) recently ran an article with an extensive list of scientific references on the topic.

Nor is the Podkletnov approach the only purported antigravity method out there. The October 1994 Master's Thesis of Stavros G. Dimitriou for the Department of Electrical Engineering of the University of Manchester (October 1994) had the understated title, "Radiation Phenomena of Specially Shaped Current Pulses." His thesis tells quite a different story! He claims nothing less than a method of generating waveforms of radio frequency electromagnetic radiation that appear to induce mechanical attraction and repulsion of pendulum-suspended masses. Recently his experiment has been replicated by several competent scientists and engineers, one of whom, Jean-Louis Naudin, has posted a description of the replication of Dimitriou's work on his www site at:

http://jnaudin.free.fr/html/stvrfpend.htm

New Energy Times Archive

On the Vortex forum on September 5, 2000, Kyle R. Mcallister posted this message, which prompted much discussion:

"On the JLNlabs Egroups list, a large discussion is taking place based on some results obtained by Jean-Louis Naudin. His work involves replication of the weight loss effects observed by Prof. Stavros Dimitriou, and he has apparently achieved positive results. The measure of gravitational reduction on the device was about 1.9%. Ben Thomas, another member of the group, has also reported a successful replication, with a loss of 1.2%. Both Jean-Louis Naudin and Ben Thomas deduced the reductions listed by observing changes in the time of swing for the device when is was acting as a pendulum. . .

"I have apparently been the next in line to achieve positive results. My device was essentially identical to that of Jean-Louis, but was powered with a 9V supply, and used a 2N2222 transistor for the oscillator. I suspended the device by a tether from the ceiling of my laboratory, and let the device rest against the top of a digital scale. The scale resolution is only 50 grams, so I pulled the tether until the weight reading on the scale was less than 50 grams. After oscillation of the device stopped, the reading was about 27.2 grams. I secured the power supply wires steadily, and moved them around without applying power to see if the readings on the scale were affected. They were not. I connected power to the battery, and observed the weight reading to change from 27.2 grams to between 26.8 and 26.9 grams, for a reduction of about 300 milligrams.

"Next, changed the configuration a bit, and ensured a better connection from the 100MHz oscillator to the antenna structure. I then applied power again, with the weight reading centered on 17.9 grams. In this test, the reading changed to 16.8 grams, with fluctuations between 17.2 and 16.7. The weight loss then was between 700 mg and 1.1 grams.

"This is a very fascinating effect, but I do not know if there could be some form of artifact that has not been thought of yet. I would appreciate the opinions of all on this list who are interested."

Other *Infinite Energy* readers will, we trust, try their hand at this rather provocative and perhaps promising research.

"AquaFever" Breakout? New Energy Technology for West Africa

In past issues, *Infinite Energy* has covered the generation of combustible gases via carbon arcs under water. This gas has been named AquaFuel, CarboHydrogen™ Gas, or more recently Magnegas™, depending on which company is purveying the technology or what particular attributes are being claimed or emphasized. Especially exciting from a physics and chemistry perspective is the suggestion that such arcs can produce more energy release than the combined electric and chemical input energy. Experimental evidence has also been put forth showing that such gases burn with exceptionally low pollution emissions.

The latest news (press release dated August 27, 2000) from one of the involved companies, AquaLux, states that it has reached a significant business deal for its fuel gas on the continent of Africa:

> In a formal signing ceremony witnessed today by U.S. Secretary of Energy William Richardson, AquaLux agreed to sell AquaFuel® alternative energy equipment to five Nigerian companies. AquaFuel is the revolutionary non-fossil alternative fuel and produces treated water as a by-product.

The release noted that sales are being made through Global Holdings Corporation, a marketing representative for AquaLux. AquaLux, which is located in Clearwater, Florida, signed an agreement with Global Holdings and UTC Nigeria plc, providing for UTC to market AquaFuel equipment in Nigeria. UTC is one of the largest non-oil companies in Nigeria and specializes in power and water facilities. Through Global Holdings, AquaLux also agreed to sell AquaFuel equipment to four other large Nigerian companies; these companies will use AquaFuel equipment to generate power and make clean water.

The release notes the following attributes of the AquaLux product:

> AquaLux equipment produces AquaFuel. Unlike diesel fuel, natural gas, or coal, which would be used otherwise, AquaFuel has virtually no harmful emissions. Further, AquaFuel production produces treated water as a by-product. In addition, AquaFuel is a superior and clean substitute for acetylene. AquaFuel will be used as a clean burning cooking fuel as a substitute for wood in conjunction with tree replanting programs to prevent desertification.

Sir Arthur C. Clarke Blasts Editors on Cold Fusion

On September 11, the British Broadcasting Corporation (BBC) transmitted the bold online headline, "Arthur C. Clarke demands cold fusion rethink." BBC's Jonathan Amos wrote, "The author and visionary Sir Arthur C. Clarke says society has made a huge mistake in rejecting out of hand the idea that cold fusion may be possible. And he mocked editors and journalists at the British Association's Festival of Science for not giving the technology serious consideration. He said the age of fossil fuels was coming to an end and society needed to find new sources of energy. Cold fusion or other 'anomalous sources of energy' might just turn out to be the answer, he said."

Bravo, again, Sir Arthur!

Amos continued, ". . .Sir Arthur said the results coming out of some labs demanded attention. 'Over the last decade there have been literally hundreds of reports from all over the world from highly qualified people and distinguished institutions of anomalous sources of energy,' he said in a recorded video address to the festival. 'They may or may not be cold fusion and in some cases have nothing to do with nuclear power.'. . . He urged journalists to do serious investigation so that they could 'start to see the future.'"

MIT's Mildred Dresselhaus
Sworn in as Head of DOE Office of Science

Institute Professor Mildred Dresselhaus was sworn in August 7 by Secretary of Energy Bill Richardson as Director of the department's Office of Science. She was confirmed by the U.S. Senate on July 26, after being nominated by President Clinton. According to *MIT Tech Talk* (August 23, 2000), Dr. Dresselhaus will oversee the office that is one of the largest sponsors of basic research in the federal government, with an

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annual budget of $2.8 billion. She is quoted in the article: "Science has been so good to me, and I thought that maybe this is the time in my life when I should serve science and the country."

The mission: "The DOE Office of Science is responsible for managing five of DOE's multiprogram laboratories and five single program laboratories carrying out a broad range of advisory, coordination and program management activities related to the DOE's energy research and development missions. The office funds programs in basic energy sciences, high energy nuclear physics, biological and environmental research, fusion energy sciences, advanced scientific computing and science education. The office plans, constructs, and operates major scientific user facilities. It also sponsors thousands of projects and hundreds of scientific institutions across the United States."

As far as is known, today not one dime of this vast research enterprise goes officially to fund cold fusion research. Dr. Dresselhaus has not yet replied to our letter of inquiry regarding a reassessment of cold fusion (*Infinite Energy*, No. 32). We patiently wait.

Hendrik Casimir (1909-2000)

Physics Today (September 2000) reports the death of renowned Dutch physicist Hendrik Brugt Gerhard Casimir, May 4 in Heeze, the Netherlands, after a brief illness. Casimir, after whom the zero-point energy force, "the Casimir effect," is named, was a student of physicist Paul Ehrenfest at Leiden University, and spent eighteen months of his graduate education with Niels Bohr. He spent 1932-1933 working with Wolfgang Pauli in Zürich.

"Cold Fusion: Fire from Water" Wins Award; "Breaking Symmetry" Now Available

Infinite Energy's seventy-minute video documentary on cold fusion has won Honorable Mention in the 48th Columbus International Film and Video Festival. The Festival is sponsored by the Film Council of Greater Columbus (Ohio). This means that the judging panel found our cold fusion video to be of "significant value and merit, requiring a final score of 5 on a 7-point rating scale."

MIT Professor Keith Johnson's cold fusion techno-thriller, "Breaking Symmetry," which is set at an "Institute of Technology" in Cambridge, Massachusetts, is now available in VHS format for purchase (see ad on page 1). The storyline in some ways suggests the reality of what happened at a real institute of technology in Cambridge in 1989-1991. In the opinion of this editor, cold fusion devotees should not miss the opportunity to view this film.

Leon Lederman Labels Cold Fusion "Junk Science"

Physics Nobel laureate (1988) Leon M. Lederman has been promoting subscriptions to *Skeptical Inquirer* magazine under the imprint of the Illinois Mathematics and Science Academy's (IMSA) "Great Minds Program." Lederman wrote: "I have found great articles in the *Skeptical Inquirer* that debunk such examples of 'junk science' as UFOs in Roswell, cold fusion, ghosts, and haunted houses, astrology, fortune tellers, crying statues, etc., etc. The exercise of rational (scientific) thinking is essential to preserving our long-term commitment to rationality. Skepticism is an essential attribute of good thinking." It is noteworthy that the enclosed ad copy from the *Skeptical Inquirer* itself did *not* list cold fusion as one of the prominent topics covered in it pages. The magazine promotional material makes this remarkable claim: "I know this sounds self-serving, but we really do think we do a better job of solving mysteries and plumbing the depths of the unknown than any other publication in the world."

Discover Magazine Bombs

Discover Magazine (October 2000) lists cold fusion among the "Twenty Greatest Blunders in Science in the Last Twenty Years." Cold fusion is sandwiched right between the 1986 Challenger space shuttle disaster and Chernobyl nuclear accident. The squib, "Very Cold Fusion," informs the vast millions of *Discover* readers, "The problem is, no other scientists have been able to reproduce their results—and not for lack of trying." Marc Abrams, editor of the science humor magazine *Annals of Improbable Research* intones, "There's always some guy willing to say, 'OK, we found something that works, but it only works once in a while, or 'We're not going to show it to you, because we're wor-

Briefs continued on page 67

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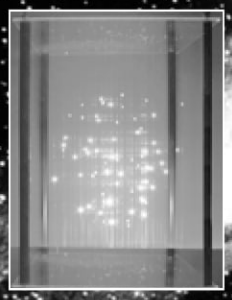

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New Energy Upcoming Events

Building Energy 2001

March 22-24, 2001
Tufts University
Boston, Massachusetts

A conference that brings together the worlds of renewable energy and high-performance green building.

Sponsored by the Northeast Sustainable Energy Association
50 Miles Street
Greenfield, MA 01301
Phone: (413)774-6051
Fax: (413)774-6053
Email Jonathan Tauer at jtauer@nesea.org

Call for Papers

The Precious Metals Academic Committee of China and the IPMI will co-sponsor a precious metals seminar March 27-29, 2001 in Hong Kong. The theme of the seminar is: Precious Metals and Clean Energy Sources

Papers in the areas of fuel cells, stationary emission control, automotive catalysts, environmental, automotive manufacturing and emission standards, and related refining and precious metals recovery are invited.

If you are interested in submitting a paper, please submit a formal abstract of up to 100 words to: Dr. Martin T. Durney, Johnson Matthey Co., 2001 Nolte Drive, West Deptford, NJ 08066 • Phone: 856-384-7210 • Fax: 856-384-7035 • Email: durnemt@jmusa.com

If you are interested in attending this seminar, please contact IPMI at 850-476-1156 (mail@ipmi.org) to be placed on the mailing list for seminar details as they become available.

Windpower 2001
June 3-7, 2001
Grand Hyatt Hotel Washington, DC

Manufacturers' exhibits, technical sessions, forums and panels, replications, and annual American Wind Energy Association industry awards

http://www.awea.org
Laura Keelan at AWEA, 202-383-2500 or Laura_Keelan@awea.org

COLD FUSION IN JAPAN

Second Annual Cold Fusion Society Conference Report

Feature Article by Jed Rothwell to appear in the next issue of *Infinite Energy*.

List of Participants at the American Institute of Physics Conference on Anomalous Nuclear Effects in Deuterium/Solid Systems, held in Provo, Utah in October 1990:

Farhang Amiri, Physics Dept., Weber State College (UT); Alan N. Anderson; Richard Anderson; Clinton Ashworth; Don Baker, Los Alamos National Lab (LANL); Marcello Baldo; Steven Barrowes; Adriano Battaglia; David Beddingfield, National Science Dept., Colorado School of Mines; V. Belyaev, USSR Academy of Sciences; Douglas N. Bennion, Chemical Engineering Dept., Brigham Young University (BYU) (UT); Haven Bergeson, University of Utah; Manuel Berrondo, BYU; Antonio Bertin, Physics Dept., University of Bologna (Italy); Peter Britton; David Buehler; Robert Bush, Physics Dept., Cal. State Polytech University; Jim Carroll, BYU; Ed Cecil, Physics Dept., Colorado School of Mines; Krystyna Cedzynska; Francesco Celani, Lab. Naz. Frascati; G.F. Cerofolini; George Chambers, Naval Research Lab; Jason Chao; V. Chexal; Chun-Ching Chien; Scott Chubb, Naval Research Lab; Thomas Claytor, LANL; James Cohen, LANL; Massimo Corradi; Dennis Cravens; Ernest Criddle, University of Ottowa (Canada); J. Bart Czirr, BYU; Michael Danos, National Institute of Standards and Technology; Henry Dart; Michael Dehn; Emilio Delgiudice; George Dragan; Beatriz Escarpizo; Kenneth Faler; F. Fernandez; John Fisher; Luciano Fonda, University of Trieste (Italy); Hal Fox; Mariusz Gajda, Physics Dept., University of Arizona; Fraser Goff, LANL; Daniele Gozzi; Rolando Granada, Neutron Physics Dept., Centro Atomico Bariloche (Argentina); M. Gryzinski; Peter Hagelstein, MIT; Peter Handel, Physics Dept., University of Missouri-St. Louis; David Harley, Physics Dept., University of Arizona; B. Kent Harrison, BYU; Marvin Hawkins; Nick Hawkins; Nathan Hoffman; Liu Huaiztu, Physics Dept., Colorado School of Mines; Graham Hubler, Naval Research Lab; Felice Iazzi; Hido Ikegami; Syed Immaduddin; Magnus Jandel, Theoretical Physics Dept., Royal Institute of Technology (Sweden); Rondo Jeffery, Physics Dept., Weber State College (UT); Carl Jensen; Gary Jensen, BYU; Nada Jevtic; X.L. Jiang, Physics Dept., Lanzhou University (China); Steven Jones, BYU; Jacob Jorne, Chemical Engineering Dept., University of Rochester (NY); John Jusko; V. Kazarinov, Academy of Sciences (USSR); Yeong E. Kim, Physics Dept., Purdue University (IN); Andrew Klein, Nuclear Engineering Dept., University of Oregon; Lori Knight; Ishida Kutshuhiko; Erno Kuzmann; Aurelio LaBarbera, Texas A&M University; Ted Lautezehiser; Jong-Qing Li; Xing-Zhong Li, Physics Dept., Tsingaua University (China); Bruse Libert, University of Hawaii; Efrain Lopez; Eugene Mallove, MIT; Osamu Matsumoto, Aoyama Gakuin University (Japan); Frederick Mayer; J.S.C. McKee, Physics Dept., University of Manitoba (Canada); Michael McKubre, SRI International; Gary McMurtry, Oceanography Dept., University of Hawaii; Michael Melick; Howard Menlove; Walter Meyerhof, Stanford University; George Miley, University of Illinois; H. Montgomery; Jerry Montgomery; Douglas Morrison, CERN, Switzerland; K.S. Mortensen, BYU; Kaneteda Nagamine, Physics Dept., University of Tokyo (Japan); Barbar Neuhauser; Nigel Packham, Texas A&M University; Michael Paciotti; E. Paul Palmer, BYU; John Peterson; Wayne Peterson, BYU; Dan Phelps; Juliano Preparata; John Pronko; Mario Rabinowitz, Electric Power Research Institute; Johann Rafelski, Physics Dept., University of Arizona; Frank Ruddy; Carlos Sanchez, Physics Dept., Universite Autonoma de Madrid (Spain); Joseph Santucci; Franco Scaramuzzi, ENEA; Thomas Schneider; Joaquin Sevilla; Gordon Shaw, Physics Dept., University of California; Eugene Sheely, University of Idaho; Masoud Simnad, University of California; John Spitznagel; M. Srinivasan, Bhabha Atomic Research Center (India); Eugenio Tabet; Akito Takahashi, Nuclear Engineering Dept., Osaka University (Japan); Hiroshi Takahashi, Brookhaven National Lab; Ryoichi Taniguchi, Osaka Radiation Research Institute (Japan); A. Tenenbaum; James Thorne, BYU; Zhongqun Tian; Yoji Totsuka, University of Tokyo (Japan); Ram K. Tripathi; Vladymir Tsarev, Dept. of Cosmic Ray Physics, Lebedev Physical Institute (USSR); Stan Vegors; Antonio Vitale, Physics Dept., University of Bologna (Italy); V. Vysotskii, Kiev State University; Jian-Chyun Wang, Dept. of Physics and Astronomy, BYU; Shu-Zing Wang; Masanori Watanabe; Joe West; Fritz Will; A. Wilson; Kevin Wolf, Texas A&M University; David Worledge, EPRI; Eiichi Yamaguchi, NTI Basic Research Labs (Japan); Ming-Chang Yang; Masashi Yokote; Li Yong-Quing; W. Zakowicz, Institute of Physics, Polish Academy of Sciences; Paolo Zeppa; Zhong-liang Zhang, Institute of Chemistry (China); Tian Zhongqun; Rongbao Zhu, Institute of Atomic Energy (China); James Ziegler, IBM Research; You-Suu Zou, Institute of Atmospheric Physics (China); Qinzin Zu, Institute of Physics (China).

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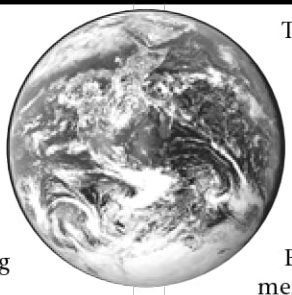
SMALL IS BEAUTIFUL

Bennett Daviss

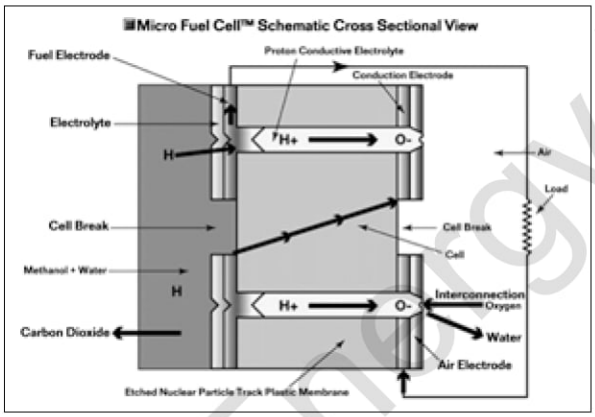


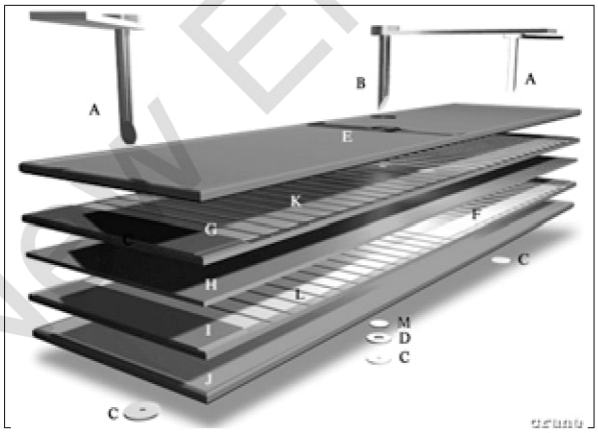
Within two years, H-Power Corp. in Clifton, New Jersey, and other firms will market a fuel cell able to power a household. Within three, automakers will unveil fuel-cell-powered cars. But while those dramatic advances are being readied, another group of scientists is driving fuel-cell research down a road less traveled.

"We looked around and said, 'Wait a minute—there is a whole market here for smaller applications,'" says Robert Hockaday, chief fuel scientist for Manhattan Scientifics, Inc. Hockaday's firm is among several developing fuel cells, ranging in size from a deck of cards to a pencil eraser, to power cell phones, PDAs, and similarly tiny devices.

Their work involves much more than just making little versions of the big machines. At such a tiny scale, Hockaday and others must invent new venues for a fuel cell's energy-releasing reactions. In the process, the researchers also are learning how to "print" the components of the little power systems like patterns on gift-wrapping paper. The completed cell that results is no thicker than a sheet of paper and malleable enough to be formed into shapes—all while delivering ten to twenty times the energy available from today's lithium-ion batteries of a similar size.

Both the large and small versions of the technology use hydrogen, either pure or extracted from a petroleum-based source such as gasoline. In a silent electrochemical reaction, the cell fractures hydrogen into protons and electrons and captures the electrons in a circuit to create an electric current.





A. Air Electrode Contact Rivet; B. Fuel Needle; C. Rivet Fold Out; D. Upper Gasket Ring; E. Lower Gasket Ring; F. Through Contacts; G. First Set of Fuel Cells; H. Fuel Manifold; I. Second Set of Fuel Cells; J. Air Manifold; K. Air Electrodes; L. Fuel Electrodes; M. Contact Washer.

Diagrams courtesy of www.mhbc.com

The usual byproducts are water, usable heat, and—if a hydrocarbon-based fuel is used—carbon dioxide.

Pure hydrogen enters the cell through the anode, while air enters through the cathode. The anode and cathode are separated by a polymer electrolyte membrane or PEM (giving the architecture its moniker of a "PEM fuel cell"). Each electrode is coated on the side nearest the membrane with a catalyst, often platinum.

When hydrogen contacts the platinum or other catalyst, the hydrogen's protons and electrons part company. The electrons enter an external circuit as current; the electrolyte membrane channels the protons to the cathode, where they combine with the "used" electrons and oxygen from air to form water and to make heat. The leftover carbon from petroleum-based fuel is given off as carbon dioxide.

Engineers building fuel cells for use in cars and trucks have one eye on their drawing boards and the other on the existing infrastructure for producing and delivering petrol. As a result, initial fuel cells for transportation uses will extract hydrogen from diesel or gasoline. That requires the luxury of space that vehicles afford: the cells need pumps to move the fuel, fans to dissipate heat, and filters to scrub corrosive sulphur from the raw fuel before it reaches the sensitive catalysts and electrolyte.

But minicells don't have that luxury. Micromachining techniques aren't yet able to deliver tiny moving parts precisely sized or energy-efficient enough to build into fuel cells the size of your little finger's nail. Also, while people might be used to riding atop several gallons of explosive fuel as they drive, they might be less blasé about carrying a vial of gasoline in their pockets as a necessary part of a cell phone or pager.

That poses three fuel-related challenges to the minicell's builders. The first has been easy to surmount: finding a cheap, nonexplosive fuel that could be slipped into cartridges the size of the small batteries that people already use. Minicell designers have settled on a mixture of methanol and water, a blend that has the additional advantage of containing no sulphur. Already, Hockaday and others have successfully tested small canisters of methanol the size of AA batteries to deliver hours of power to portable devices. When the methanol inside is used up, a user pops out the canister and pops in a new one, just as batteries are used now.

The second challenge—finding a way to move fuel from the reservoir to the catalyst—is a bit more difficult than the first. In small cells, an adequate and steady supply of fuel can enter the cells' reactive chambers simply by letting the fuel evaporate in contact with air and waft through microchannels in the cell to the catalysts. Alternatively, researchers are experimenting with various ways to wick the liquid methanol from cartridge to catalyst. "But the problem that remains is how to hold the hydrogen in such a way that it's only used as needed," says Morton Litt, professor of macromolecular science at Cleveland's Case Western Reserve University. Devising a sort of "just-in-time" approach that mimics an auto engine's fuel pump "is a problem that remains," he says.

The third challenge is as great as the first one is small. Because hydrogen isn't yet a widely available and affordable fuel, designers have to find a way—inside the fuel cell—to separate hydrogen atoms from cheap, readily accessible hydrocarbon compounds. Oil refineries separate hydrogen from raw petroleum by "steam reforming," a process demanding such high temperatures and complex reactions that it would be impossible to carry them out inside a minicell.

Small is Beautiful continues on page 39

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Center of London

PANIC BUYERS START TO STRIP SUPERMARKET

BRITAIN COMES TO A STANDSTILL

Headlines from the Daily Telegraph, September 13 and 14

UK FUEL CRISIS

Soo Seddon

Britain is slowly emerging from the event horizon, one of those improbable gaps in the space-time continuum, via which the entire country was thrust backwards into a soft-focus, mellow period, strangely reminiscent of the 1950s. A too brief return to the era of the empty, open road, where cars were a luxury and not a necessity. Those delicious, bygone salad days of bicycling families; the steady clip-clop of horses hooves along rustic lanes; uncontaminated, wholesome air—and rationing. This temporary time-warp was the aftermath of the farmers and hauliers blockade of oil refineries throughout the UK in protest against the huge tax levied on fuel (around 75% of the pump price per gallon goes straight to the Treasury). Over the past few years, the prohibitive levels of fuel taxation have seriously eroded the profit margins of scores of small farms and businesses, forcing many to downsize drastically or cease trading altogether. A desperate appeal to the government to redress the balance went almost unnoticed until the effects impinged on our entire social infrastructure and sent anquished ripples through the otherwise unstressed routines of the Great British public, whose widespread support for the principles behind the blockade began to be severely tested.

There was precious little post-war bonhomie in the snaking petrol queues.

Oil tanker drivers themselves rallied to the cause of the protesters and refused to cross picket lines to deliver to gas stations. As petrol stocks dwindled, garage queues lengthened, tempers frayed, and the scene was set for some future psychologist to write the definitive thesis on mankind's manic need to possess tankfuls of fossil fuel, and how merely the threat of withdrawal of this bounty contained all the menacing ingredients necessary to brew civil war.

It took the government a few days to appreciate the seriousness of the situation, then they acted to put the armed forces on stand-by to ensure continuity of fuel supply to the emergency services.

Within a few days medical supplies and blood stocks were depleting rapidly and a lot of commuting doctors and nurses became unable to attend their workplaces. Postal services were disrupted, industry and commerce suffered, and many schools simply closed their doors for the duration.

Supplies of fresh foodstuffs ran low and, due to panic buying, many stores were forced to impose restrictions on how much bread and milk an individual customer could purchase. The entire UK distribution network came very close to total collapse and some folks went completely bananas.

The unending lines of waiting cars blocking the highways around petrol stations heralded the dawn of a new Rush—this time for Black Gold (Texas Tea?).

An Internet auction bidder paid £102 for two gallons of premium unleaded and several garage owners fortunate enough to still have full tanks raised the price per litre from 80 pence to £2.50 . . . and people paid up!

Petrol stealing became rife. Hospital workers, who were permitted fuel as an emergency measure, found their cars had become a prime target for thieves.

One woman blew up her vacuum cleaner trying to siphon petrol from one car to fill another. Incredibly, she was unhurt, even though the Hoover went up like a bomb when gas fumes hit the electric motor.

I saw one chap actually shooting fuel at his car from a few feet distance in a frenzied attempt to fill even the air gap and squeeze the last drop into his vehicle.

A taxi driver, who had hoarded hundreds of gallons of fuel in beer barrels in his living room, caused the evacuation of an entire residential area when one of the barrels sprang a leak, filling the neighborhood with choking fumes.

There was even piracy on the high seas as, in Devon, motorists armed with jerry cans boarded a fuel barge in the middle of the harbor, demanding refills with menaces.

Throughout it all, the truck drivers continued their "go slow" protests, blocking UK cities and major highways by crawling in convoy at 5 mph. How much longer, I wondered, before even they ran out of the fuel to continue their venture?

There were frantic political spoutings from the leader of the opposition, who swore his team would immediately reduce fuel taxes—*if* they got elected, of course.

Every news bulletin began with a hasty review of the latest exploits of those latter day folk heroes, the "Farmers and the Truckers." Not surprisingly, there were a few unfortunate (and presumably unintentional) spoonerisms from commentators and politicians.

It had taken less than a week to achieve what green lobbyists had striven for for decades as many citizens resorted to alternative forms of transport.

Horse power enjoyed a revival; a mum from South Wales took over the school-run for her entire village with a horse and wagonnette—and the kids loved every minute of it.

The sale of bicycles soared along with that of lightweight scooters and roller boots and a few recommissioned Sinclair C5s were spotted cruising languidly down deserted London streets.

Even when the "Farmers and the Truckers" eventually ended their blockade, it took several days to re-stock even a small percentage of gas stations (at the time of writing, almost two weeks later, only 50% of stations are fully re-stocked).

Part of the problem was that as soon as fuel was delivered, it was immediately purchased by panic-stricken motorists, some of whom had queued at gas stations for up to eight hours awaiting the arrival of tankers.

In one instance, so many cars lined the road to the service station that the tanker couldn't squeeze through to deliver its fuel.

The nation appears to have realized, perhaps for the first time, just how totally dependent our social infrastructure is on petroleum products and how easily the delicate balance can be upset, resulting in disorder, chaos, and even violence on the streets.

Normal service is slowly being resumed, but locking car fuel caps, gas cans, and hosepipe are still virtually unobtainable!

[October 31, 2000 Update] Back in September, fuel protesters gave the government sixty days in which to take some positive action on fuel prices or threatened to resume their blockading of refineries. To date, the government's only practical response has been to train British troops to be emergency tanker drivers.

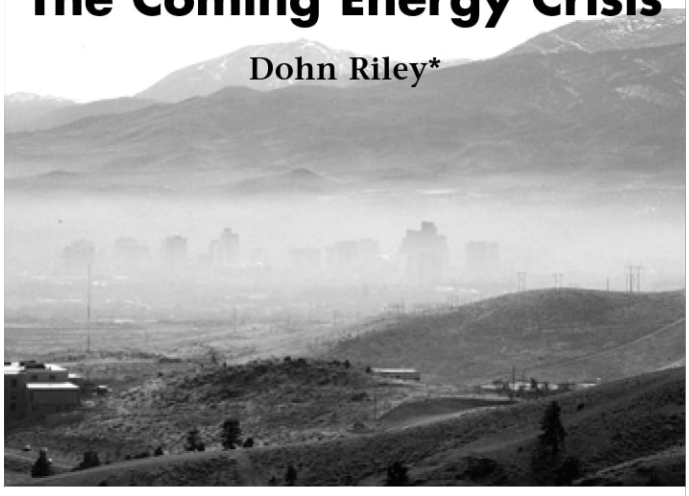
The sixty-day deadline expires on November 13 and reportedly plans are in hand for a protest march from Jarrow in the North East of England to London, creating another four-day go-slow on Britain's major roads.

❑❑❑

New Energy Times Archive

The Coming Energy Crisis

Dohn Riley*



Two hundred years ago, the world experienced an energy revolution that launched the Industrial Age. The catalyst to this epochal shift was ordinary black coal, an energy-rich hydrocarbon that supplanted wood as the primary fuel. The energy stored in coal gave inventors and industrialists the power they needed to process steel, propel steamships, and energize machines. A century later, the industrialized world's thirst for energy had increased tremendously. Petroleum and natural gas were exploited as versatile and high quality energy products, and soon joined coal as principal fuels. Fifty years later, scientists tapped uranium to fuel nuclear reactors and provide atomic energy.

Today, cheap energy is the lifeblood of American society. But there is a dangerous dark side to relying on non-renewable resources like coal, oil, natural gas, or uranium to supply our growing energy demands. The supply of these fuels is physically limited, and their use threatens our health and environment. Fears of global warming aside, burning fossil fuel releases chemicals and particulates that can cause cancer, brain and nerve damage, birth defects, lung injury, and breathing problems. The toxic stew released by combusting hydrocarbons pollutes the air and water, and causes acid rain and smog. Nuclear energy, once touted as "too cheap to meter," has never been economically successful when all costs are factored in, and fear of disasters like the Chernobyl reactor melt-down have virtually shut the industry down in the U.S. and Europe. Inexpensive and seemingly abundant nonrenewable energy fueled the twentieth century economy, but geologists, climatologists, environmentalists, and many others are warning that the honeymoon may soon be over.

Coal is the most abundant of the carbon-based fossil fuels, but it is also a leading threat to human health and the environment. Coal currently provides 24% of the world's primary energy requirements and, in 1999, generated 57% of all the electricity used in the U.S. Existing coal reserves may be large, but they won't last forever, and health and environmental costs limit its potential as an acceptable fuel in the future. Burning coal currently accounts for 43% of all annual global carbon emissions, about 2.7 billion tons.

The top ten most air-polluted cities in the world—nine in China, one in India—all use coal as a primary energy source. Atmospheric scientists have tracked large dust clouds of particulates and sulfur from Asia to the United States' west coast. In the U.S., coal reserves surpass those of oil and natural gas by about two hundred years and can be mined domestically, but using coal simply because there is plenty of it would be a serious mistake. Air pollution, acid rain, greenhouse gas emissions, and other health dangers associated with processing coal into electricity take their toll on countless people around the world. Western governments rarely discuss "coal" and the "future" in the same sentence anymore, but burning coal has become a global problem that respects no international boundaries.

Cheap and abundant oil is an intoxicating elixir that the world's industrial nations have guzzled down as if there is no tomorrow. Petroleum currently accounts for 40% of the world's energy, but many geologists anticipate an oil supply crisis sometime within the next two decades when global demand will exceed supply. While some argue that huge deposits of oil may lie undetected in far-off locations of the globe, experts point out that there is only so much crude in the world, and industry has found about 90% of it. The world's burgeoning population is dependent on food grown with petroleum-based fertilizers, cultivated by machines running on cheap fuel.

In 1950, the U.S. was producing half the world's oil. Fifty years later, we don't produce half our own oil. Domestic production peaked in 1970. Originally, America was blessed with about 260 billion barrels; only one country, Saudi Arabia, had more. Although the U.S. is now the world's third largest producer, about 65% of our known oil has been burned. It's downhill from here. The U.S. has 4% of the world's people but slurps down 25% of the world's oil. If the Chinese annually consumed oil at the same per capita rate as Americans, there would be none available for anyone else.

Natural gas (methane) is being touted by energy providers as an abundant clean fuel for the twenty-first century. It is forecast to be the fastest growing primary energy source, because it burns cleaner than coal or oil. But this resource is also nonrenewable, and the Department of Energy states that the U.S. has only 3.5% of the world's total natural gas reserves—enough to last about sixty-five years. More than 70% of the world's proven natural gas reserves are located in the politically risky Persian Gulf and former Soviet Union. After 2020, the bulk of the world's remaining supplies of both oil and natural gas will be centered there.

According to the Energy Information Administration, natural gas provides 27% of the energy used today. Similar to their consumption of oil, Americans consume more than their share of natural gas; in 1997, the U.S. used 28% of the world's total production. Consumption in the U.S. and Canada is expected to grow 50% by 2020, enforced in part by the Clean Air Act Amendments of 1990, which are designed to curb acid rain, toxic emissions, and urban air pollution. Compared to the combustion of oil and coal, natural gas combustion is relatively benign as a contributor to air pollution. American troops have already

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shed blood in the Middle East protecting our oil interests; relying on natural gas for a primary energy source has similar costs and risks.

Nuclear energy presents similar problems to those associated with non-renewable fossil fuels. The planet's supply of uranium is limited, and mining the ore is hazardous to human health. Worse, the radioactive waste byproducts are a lethal long-term danger to the environment. In 1999, nuclear energy provided about 17% of the world's electricity, but splitting the atom to boil water is like using a chainsaw to cut butter. The health and environmental costs of using atomic energy have become serious obstacles to the industry. Disposal of radioactive waste has proven to be a much greater problem than originally estimated. Nuclear power does not contribute to air pollution and greenhouse gas emissions, but a good solution to safely storing tons and tons of radioactive waste, a nuclear byproduct that remains dangerous to all life-forms for thousands of years, remains elusive.

In the 1950s and 1960s, atomic energy was hailed as an unlimited panacea to the pollution problems generated by fossil fuels, and destined to be so cheap that electric companies wouldn't even put meters on houses. Today, there is little support among Americans and Europeans for fission nuclear energy. Nobody wants a nuclear reactor in their backyard, and frightening publicity regarding reactor meltdowns at Chernobyl and Three Mile Island has only reinforced these fears. Health officials estimate that at least 4,365 people who took part in the Chernobyl cleanup have died in the Ukraine. [Editor's note: These high figures are disputed by some experts.—*EFM*] The risk from nuclear power plants and nuclear-waste disposal sites demands a vigilance and longevity of our social institutions that is unprecedented.

Coal, natural gas, and uranium are alternative non-renewable energy resources to cheap oil, but each has advantages and limitations, and none is as versatile as petroleum. The replacement of oil will require a mix of energy sources, including clean renewable energy such as solar and wind power. This adjustment will involve substantial reorganization of the world's economic structure and significant lifestyle changes in the industrialized countries.

Economists like to point out that the world contains enormous caches of unconventional oil that can substitute for crude oil as soon as the price becomes competitive. It is true that resources of heavy oil, tar sands, and shale deposits exist in large quantities. But the industry will be hard-pressed for the time and money needed to ramp up production of unconventional oil quickly enough to forestall an economic crisis. Experts who point out the approaching end of Hydrocarbon Man are not pessimists or alarmists; they are simply saying now is the time to plan, lest the end of cheap fossil fuels be an unprecedented disaster in human history.

Renewable energy will play a major role in the energy industry of the twenty-first century and beyond. British Petroleum, Royal Dutch/Shell, and other companies are investing heavily in renewable sources of energy. Industry experts realize that these alternative energy systems not only help reduce greenhouse gas emissions, but they predict that over the next half century, renewables may grow to supply half the world's energy. Successfully generating electricity by harnessing the perpetual power of the Sun and wind is not only technologically feasible, it is already a reality. Solar power relies on the energy produced by nuclear fusion in the Sun. This energy can be collected and converted in different ways, such as simple water heating for domestic use or by the direct conversion of sunlight to electrical energy using mirrors, boilers, or photovoltaic cells. The technology is improving and the economics are getting more competitive. Photovoltaic panels don't generate electricity at night, but they can be used to produce hydrogen in the daytime, which can then be stored.

Scientists and engineers are continually improving the efficiency of renewable energy systems. Humans have been harnessing the wind for thousands of years, and are now cleanly producing electricity with it. Air flowing through turbines or spinning blades generates power that can be used to pump water or generate electricity. Wind energy is now the world's fastest growing energy source and has become one of the most rapidly expanding industries.

Wind power has some drawbacks; a "wind farm" requires extensive areal coverage to produce significant amounts of energy, and bird fatalities have been a concern. The wind industry is modifying equipment to address this issue but also points out that countless wild creatures are killed every year as part of the acquisition and distribution of conventional energy sources.

Hydroelectric power is another source of renewable energy. Hydroelectric dams, however, are no longer considered environmentally benign sources of power. Fisheries and other wildlife habitat have been severely impacted on many dammed rivers. Most of the world's hydroelectric dams are historically recent, but all reservoirs eventually fill up and require very expensive excavation to become useful again. At this time, most of the available locations for hydroelectric dams in the U.S. are already developed.

Humans have been burning biomass materials since the dawn of time, and it is still the principal fuel used in many parts of the world. Incredibly, just 120 years ago, wood was the chief energy source in the U.S. But today's economy runs on oil, and despite significant government support, converting wood to alcohol, or corn to ethanol has proven neither economical nor energy efficient. Researchers have recently discovered how to produce clean combustible gas from waste products such as sewage and crop residue, but biomass gas will not soon replace petroleum as the fuel of choice.

Hydrogen has been touted as the fuel of the future. It is the most abundant element known in the universe and can be burned cleanly as a fuel for vehicles with water as the main combustion byproduct. Hydrogen can also be fed into a fuel cell, a battery-like device that generates heat and electricity. Using hydrogen instead of gasoline or diesel will significantly reduce the health hazards and medical costs associated with the exhaust from conventional internal combustion engines. But the large-scale extraction of hydrogen from terrestrial resources such as water, coal, or natural gas requires a lot of energy, which is currently produced by burning fossil fuels. Commercial hydrogen production is expensive and only shifts the pollution from vehicles back to the power plants. Producing hydrogen

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with solar power is the dream of environmentalists and renewable energy proponents. If done successfully, hydrogen and electricity will eventually become society's primary energy carriers in the twenty-first century.

Geothermal energy left over from the original accretion radioactive decay seeps out slowly everywhere, everyday. In certain areas, the geothermal gradient (increase in temperature with depth) is high enough to exploit for the generation of electricity. Another form of geothermal energy can be tapped from the planet's surface. Soil maintains a relatively constant temperature throughout the year and can be used with heat pumps to warm a building in winter or cool a dwelling in summer. This form of energy can lessen the need for other power to maintain comfortable temperatures in buildings, but it cannot be used to produce electricity.

Tides, waves, and the heat differential within the world's tropical oceans are potent sources of clean energy. Various countries around the world are investing time and money into the technologies that may tap these renewable power producers, but overcoming the obstacles inherent in these systems will be difficult. The media and industry claim that renewable energies are not yet economically competitive with fossil fuels. Perhaps not, but when one considers the health and environmental costs associated with burning coal and oil, the price of renewable energy becomes more attractive. No renewable energy system will single-handedly replace oil, but together they will become a very important part of the energy mix of the future. Traditional renewable systems are a logical step in the transition to advanced alternative energy sources such as cold fusion. Although scientists and engineers are working feverishly to overcome the various obstacles associated with "new energy" technologies, society should not stand by quietly while researchers wait for a breakthrough. Burning petroleum is polluting our air and water, and the bulk of the world's reserves of cheap oil are concentrated in the politically volatile Persian Gulf. Getting that oil will likely cost billions of dollars and possibly the lives of American soldiers.

Every year American's consume 25% of all the energy produced in the world, but that conspicuous consumption can't last forever. To that end, the U.S. Department of Energy established the Renewable Energy Production Incentive (REPI) as part of an integrated strategy in the Energy Policy Act of 1992. This act promotes increases in the generation and utilization of electricity from renewable energy sources and furthers the advances of renewable energy technologies. In 1996, the Renewable Energy Policy Project released "The Environmental Imperative," a plan for the energy market to draw on renewable energy to avoid the severe environmental impacts of the fossil fuel cycle. This plan outlines the environmental imperative for accelerating the use of renewable resources. It is important to realize that it usually takes thirty to forty years to significantly shift fuel patterns and that using electricity as an alternative to oil will require a major adjustment by the American public. The window of opportunity to make this energy transition without a major economic disruption will not be open for long.

Dohn Riley graduated from Massachusetts Institute of Technology in 1970 with a Bachelor of Science in Earth Sciences. In 1976 he received a Masters from Stanford University in Geophysics. Dohn has worked as a geophysical consultant in a variety of fields and taught college classes in Physical Sciences for twenty-two years at Sierra College in California. He has been Executive Director of the Alternative Energy Institute, Inc. since its inception in 1997. Dohn also currently owns and manages a graphic design business, Riley Works, located in Tahoe City, California.

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"We're reinventing that process to fit it into a small scale," says Ed Baker, a technical group manager at the U.S. Department of Energy's Pacific Northwest Laboratory, run by the Battelle Memorial Institute. "Our concept is to use microchannel devices to reduce or eliminate the cell's resistance to the heat transfer and mass transfer involved in reforming." Although the details are under wraps, he says, "You can compare it to a semiconductor chip. We're not building a chemical reactor on a chip, but there are architectures that let us build up these things in sheets."

That general approach isn't limited to fuel reformers. A number of researchers are testing entire fuel cells made up of thin films laid down in contact with each other. In the process, a layer of material a few microns thick is deposited on a substrate, just as holograms are printed on gift wrap. The processes even use the same technique, called vacuum deposition.

"We lay down a permeable insulator with pores as small as 15 nanometers," says Robert Hockaday. "That establishes a rigid foundation. Then we lay down a circuit pattern, deposit catalysts, and finally impregnate that with a solid plastic electrolyte. The whole thing is the thickness of a sheet of paper." The prototype won Industry Week magazine's 1999 "Technology of the Year" award.

Working with Baker's group at Pacific Northwest, Litt's research team at Case Western has been pioneering techniques for making such cells cheaply and abundantly. The team won notice last spring for creating a fuel cell with a volume of just five cubic centimeters. In the course of building it, the researchers also have been developing a library of "inks"—each an element used to make fuel cell circuits—that can be printed on a substrate the way words are printed on paper.

"It took us about a year," Litt says. "The inks have to be permeable to whatever gas you're working with. They have to be conductive. You have to have a way to lay each one down in just the right thickness. And the inks have to adhere to the substrate, so every time we reformulated the base we had to reformulate the inks as well."

The effort seems to have been worth it. Last summer, Litt and company demonstrated that by pulsing their cells' power outputs, the bean-size units delivered ten to twenty times the continuous power that similar-size lithium-ion batteries could. "What we've created is a sort of superbattery, able to deliver much more energy than conventional little batteries," Litt says.

Not everyone is impressed. Frank Gibbard, CEO of H-Power, a leader in fuel-cell design, says his company isn't interested in the idea of printing fuel cells. "We concentrate on things we think will be practical within five years," he says. "The power per unit weight or volume on printed systems is very low, at least right now. The technical challenges are formidable."

But so are the possibilities. Baker's group is pondering ways to wrap thin-film reformers around fuel cells, or even to combine the two and wrap them around a fuel source. Before 2005, the group will deliver to the U.S. Army a working "all-in-one" device the size of a soda can to power a soldier's increasing number of portable electronic devices. Within the same time frame, minicell researchers agree, commercial devices will hit the market—most often to give time out to or recharge conventional batteries. Thin-film cells that can be folded or spindled also raises the prospect of eventually being able to build a fuel cell as part of the case of a cell phone, PDA, or other appliance.

Says Hockaday, "We're not just laying down sheets of fuel cells. We're also laying down an alternative approach to how fuel cells can be built."

Bennett Daviss contributes to several national and international magazines including Discover, New Scientist, and Air & Space.

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GREEN GREENER GREENEST

Soo Seddon

The current fashion for promoting sustainable energy technologies has spawned a new tourist industry—the Green Visitor Centre. I explored a recently created one in East Anglia.

Opened to the public last year, the Ecotech Centre at Swaffham, Norfolk is a conservationists dream. Its location on the site of a former firecracker factory gains it instant "greenie" points—the UK government is keen to direct new building projects onto these so-called "brown field" sites.

The main building is constructed almost entirely of glue laminated recycled timber insulated with compressed shredded newspaper—even the emulsion paint used is organic.

The Centre's low-energy lighting system is powered by an 800 m^2 passive solar collector on the south facing elevation and a biomass boiler provides winter heating to Ecotech and many of the small factory units in the adjacent business park.

The development of a rainwater recycling system is currently in progress.

Within the several acres of surrounding land, there is an impressive organic garden, a wildlife sanctuary with a butterfly breeding area, and a recycling plant which converts waste from the Visitor Centre into compost for the gardens.

The Ecotech Centre contains many interesting interactive displays of various kinds and has a mini-film theatre housed inside a giant oil drum.

The real star of the show, however, is the 97 m high Ecotricity wind generator on the perimeter of the site. One of only two variable speed turbines in the country, at wind speeds of 30 mph it generates 1,500,000 watts and produces, on average, half of the electricity needed to power the nearby town of Swaffham (population of 6,000).

The generator weighs 40 tons and each of the three 3-ton blades is, at 33 m, longer than the wing of a jumbo jet. If the wind direction changes for more than one minute, the blades will realign themselves appropriately. The entire set-up is computer controlled from a small hut at the base of the tower.

300 steps to the top

An observation gallery circles the tower, just below the nascelle, at a height of 60 m. I (eventually) braved the climb up 300 tightly-wound spiral steps to the top—no easy task for someone very worried by heights.

This upward trek, as the safety warning above the entrance states, is definitely "not for the timid."

There are two rest stages on the ascent in the form of narrow metal platforms, and even at the first one I felt like admitting defeat. A small child became quite hysterical and had to be taken back down—I have to confess he only just beat me to it.

Onward and upward. The climb seemed unending and didn't get any easier. The structure flexes in the wind and with the action of the rotating blades. The outer walls close in sharply nearer the summit, leaving barely a sufficient gap to grasp the handrail.

If they could find a way of harnessing the nervous energy I'd expended on the terrifying climb, they could have shut down the generator for a few hours with no noticeable power loss. . .

At the top, the flexing action was even more pronounced and gave the sensation of being afloat on very choppy waters. The panoramic view of East Anglia, however, was wonderful, if a little disorientating when viewed from in between the giant white blades which whirled around just a few meters from the protective plexiglass of the observation tower.

Once safely down to earth, after an only slightly less fraught descent, the tour guide handed us certificates of achievement. . .When I stop shaking, I think I'll get mine framed.

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Experience with Lithium Catalyst in a 1987 Lincoln Town Car

Mark Hugo*

Over the last three years I have been putting a mild "additive" into my fuel when I gas up my 1987 Lincoln Town car. Fortunately early this spring I became "lazy" and after running out of the "catalyst," I began fueling my car with straight fuel. (See *IE* No. 18, "Nuclear Augmented Compustion," and following articles on this lithium catalyst.)

After about three months, I gradually began to notice my mileage tending downward, eventually leveling out in the 17, 18, or 19 MPG range, with an occasional 20 MPG on a pure "road trip" (*i.e.* all freeway for 200 or 300 miles).

About a month ago (July 4th weekend) I again purchased my favorite "catalyst," (aka, GUNK corporation's White Lithium Grease) and again began spraying the grease down the fuel pipe for ten seconds once every other tank full of gas.

After the first week, I made a road trip to Hoyt Lakes, Minnesota to participate in an in-line skate race. This put about 360 miles on the vehicle, and my mileage was 22.7 MPG for the trip.

Subsequently I obtained 20.5 and 21 MPG with overall driving in the "metro area" of Minneapolis/St. Paul (covering about 700 miles).

Again this weekend I drove to another weekend in-line skating event, and the driving put roughly 260 miles on the vehicle. The conditions for the drive were: 75 mph most of the way on cruise control. Wind out of the south 15 mph on the way north on Saturday morning and out of the south at 20 mph on Sunday afternoon. Air-conditioning on the entire trip. Average MPG: 22!

Now we have an interesting comparison here in that I have the precise mileage figures from a 1600 mile trip from Phoenix to Minneapolis in June, in a 1986 Chevy Brougham, also 5 liter, but with a carburetor. Those numbers were: 406 miles at 20.0, 358 miles at 20.0, 340 at 21 mpg, 359 at 21 mpg. Full A/C, 70 mph, but the last two numbers definitely helped with a south wind behind the car. Interestingly, the "in city" mileage just before the Phoenix/Minneapolis trip was 15.1 mpg and the first "in city" mileage in the Minneapolis area was 15.0 mpg. Since the owners of this auto keep meticulous mileage records, they are now being transitioned to the catalyst and we will see what the result is.

The general theory on this "catalyst" is that the extra energy is *not* due to a catalyst effect, but rather to the $Li_7 + H_1 = 2\ He^4$ nuclear fusion reaction happening within the combustion plasma due to some not yet understood "dense matter" effect which allows a fusion to occur at much lower than "pure fusion plasma theory" would predict.

Unlike the Pons and Fleischmann experiments, this "experiment" can be performed by *anyone* and done cheaply and easily. GUNK'S Lithium grease is a whopping $3. One can will last for over a year, so that $1,000 worth of fuel can be treated for roughly $3. That means, presuming a 15% mileage increase, a savings of $150 for a $3 investment. Or a 50:1 ROI. Not bad for a minor "experiment."

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If you would like to contribute articles (1,500 words or less) on renewable or conventional energy, please submit them for consideration to:

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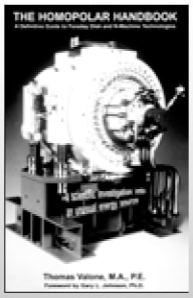

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New Energy Research Laboratory ✧✧✧ Device and Process Testing Update

Ken Rauen and Eugene Mallove

Thin-Film Cathodes and John Dash Cells

In 1999, Cold Fusion Technology, Inc. contracted with Prof. George Miley's group at the University of Illinois, Champagne-Urbana to design and produce ten thin-film cathodes that might be suitable for excess heat production in educational kits. These we hoped to market, after determining whether such cathodes really did produce adequate excess heat—the main objective of such a hoped-for commercial demonstration cell.

Professor Miley's group and students prepared a significant report of the project's results and transmitted this to us. These results have been discussed, in part, by Professor Miley at the American Physical Society meeting last March in Minneapolis, as well as last May at ICCF8, the Eighth International Conference on Cold Fusion. In recent months we obtained from the Miley group ten initial "first cut" cathodes, thin films of palladium and nickel deposited on a special glass substrate structure. We hope that these cathodes prove themselves.

At this time, we have contracted with Dr. Edmund Storms to test these cathodes in his very well-equipped Santa Fe, New Mexico laboratory. Storms has decided to employ a Thermonetics calorimeter, which Jed Rothwell (out of his own personal funds) had acquired for Dr. Storms. This is of the same design that Ed Wall had been using at NERL here in Bow, New Hampshire to begin testing prototype cells fashioned after the designs of Professor John Dash and Jon Warner at Portland State University.

In early September, Ed Wall decided to leave NERL for other pursuits, one of which is the study of patent law, possibly on the road to doing patent agent work. This, in part, explains why we have decided at this time to allow Dr. Storms to perform definitive tests on the Miley thin-film cathodes, as well as Ed Wall's initial design of a Dash cell replication. Ed Wall's two-year effort here at NERL helped us to significantly upgrade various capabilities, such as data acquisition and other infrastructure, in addition to his tireless work on experiments. His dedicated role will be missed. NERL is hopeful that in 2001 new projects and funding will lead to additional staffing opportunities for technically trained individuals. (Candidates interested in applying for such potential positions are asked to submit a resumé and cover letter to NERL Director Dr. Eugene Mallove, stating their objectives and interests—P.O. Box 2816, Concord, NH 03302-2816.)

Hydrosonic Pump

The Hydrosonic Pump still awaits mounting and alignment. NERL is now staffed by only one scientist, Ken Rauen, which forces us to prioritize projects. A local machinist was hired to help with the installation and alignment.

Mobberley Electrodeless Arc Discharge

The Eighth International Conference on Cold Fusion in May, 2000, presented a surprise. A newcomer to the field of low-energy nuclear reactions, Peter Mobberley of England, astonished some at the conference by announcing a new form of underwater electric arc discharge. He developed a new technique to get around the electrode decomposition problems experienced by Mizuno and Ohmori (see *IE* No. 20, *IE* No. 28, *IE* No. 32, and Device and Process Testing Updates in *IE* Nos. 22, 26, and 32). The arcing is removed from the electrodes by concentrating the electric field through the holes in a commercial, ceramic pepper shaker ("pepperpot" in British parlance). The arcing occurs at the ceramic holes instead, providing the electrodes have enough surface area. One electrode is inside the shaker, and the other is outside the shaker and inside the cell's electrolyte container, such as a beaker. Mobberley claims excess heat is released in this system, as much as 70% excess. The arc, which is said to produce the excess heat, changes from a typical bluish white arc to a lilac pink arc. NERL could not resist these claims and the seeming simplicity of the apparatus.

Ed Wall performed an initial "quick and dirty" experiment in June to produce the pink arc and to roughly estimate the heat released by temperature rise to the solution's boiling point. Seventy percent excess should be easy to observe. The pink arc was not seen then. It was difficult to arc at all, and when it did arc, it was a white arc. On top of that, it spattered and splashed terribly.

The Mobberley project is now handled by Ken. A new apparatus was needed, because the open beaker method splashes hot lithium-hydroxide all over the place; significant water vapor is lost even before the solution reaches the boiling point; and hot hydroxide solutions are excellent carbon dioxide scrubbers that form lithium carbonate, a limestone-like precipitate that makes a terrible mess of the test vessel.

A stainless steel, dewar-like flask was chosen as the reaction vessel. The metal construction provides the outer electrode. The inside of the double-walled flask is not evacuated like a true dewar; it is ported with hose barbs that are used as a water circulation jacket, providing the means to do calorimetry by temperature rise of water passing through the jacket. The stainless steel vessel was capped by a clear polycarbonate window, sealed by an O ring. Mobberley specified concentrated LiOH. The initial solution used by Ed Wall was most likely not concentrated enough, because it takes a long time for hydroxides to dissolve.

Power input was from a 208 VAC (alternating current is a new twist by Mobberley) source through a variac, and the electricity delivered to the cell was monitored by an Amprobe voltage and current data-logger. Heat output was measured by water jacket temperature rise multiplied by cooling water mass flow and specific heat capacity. Temperature was measured by 30 gauge type-J thermocouples on plastic-hose-isolated brass fittings at the inlet and outlet jacket ports, connected to a Hewlett-Packard data logger. Flow was measured by total water weight for the test period. The heat capacity of water is 1 calorie per gram-°C. Actual electrolyte solution temperature was monitored by a mercury

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Evan Ragland*

Foreword

Whenever I become impatient with progress in nuclear physics I remind myself that I am several years older than the neutron. That we have come so far in such a short time in our understanding, first of the atom and then of the nucleus, is truly remarkable. Still, new technologies are to be visualized and conceived using the latest concepts, postulates, theories, and laws of physics. As an engineer I must visualize, feel, sense, and have faith in these premises. In recent years I have realized difficulties visualizing such esoteric concepts as gluons, quarks, glue balls, and lassos; color, charm, strangeness, and inexact symmetries; Z-zero particles and Higgs bosons. I am reminded all this—SU(3), the eightfold way—is an intellectual structure inaccessible to the senses.[1] But since I must sense, visualize, and believe the physical models of my mind, I have resorted to the philosophy of empirical equivalence; *i.e.,* the idea that alternative theories can plausibly account for the same phenomena.[2] So I have fashioned concepts and pictures of mass and elementary particles and nuclear constructs that are accessible to the senses. My and others' ideas are visually described in this presentation, which begins with a Neils Bohr billiard ball example from 1936.[3] It is fun to revisit old problems in light of recent knowledge. I hope the reader finds the format of illustrated discussion interesting and stimulating.

Introduction

As the twenty-first century begins, uncertainty still clouds our understanding of the atomic nucleus. The nuclear strong force lingers as a nebulous issue. The notion that protons and neutrons undergo *internal changes* bides as well.[4]

Early on, physicists visualized a nucleus consisting of protons and free electrons. In 1928, George Gamow proposed a liquid drop model postulating surface tension as the strong force holding the nucleus together. In 1932 these ideas changed when James Chadwick demonstrated the neutron's existence. In 1934 Enrico Fermi's research demonstrated slow neutron capture. The new phenomena begged better understanding. Neils Bohr lecturing to the Danish Academy on January 27, 1936, postulated the compound nucleus. His landmark paper, "Neutron Capture and Nuclear Constitution," was published in *Nature*, 1936.[5] Bohr visualized a nucleus of protons and neutrons—all retaining their individual identity. A nebulous nuclear strong force neutralized the electrical repulsion between nuclear protons.

The familiar clump structure of the nucleus is generally attributed to Bohr, who used a collection of billiard balls to convey his idea of nuclear constitution.[3] In his 1936 paper he took great care to generalize and not to commit to any explicit structure. His "very reasonable" concept was to assume the nucleus was constituted of entities with the same properties as those of free protons and neutrons. Nevertheless, in spite of Bohr's careful restraint science seized upon the clump or cluster model of the nucleus.

Gamow had shown in 1934 that the natural sequence of nuclei, hydrogen through uranium, evidenced a periodicity of properties similar to Mendeleev's periodic system of elements.[6] In 1949 Maria Goeppert-Mayer and Hans Jensen[7] in their *Theory of the Nuclear Shell Structure* proved the observed periodicity in nuclear structure. By 1949 it was clear that the free nucleons (protons and neutrons) of the droplet model and the assigned nucleon states of the shell structure represented conflicting nuclear constitutions. In 1952 Aage Bohr, Neils' son, and Ben Mottelson and others proposed a "collective model" combining facets of the droplet and shell models. All models assumed a nuclear strong force bound protons to neutrons and to each other. None explained the nuclear strong force beyond the surface tension tenet. These conceptual conflicts remained throughout the fifties and into the 1960s.

In 1963 Murray Gell-Mann[8] *"proposed the existence of quarks,"* subnucleon fractional charges *"permanently confined in some way"* inside protons and neutrons. In 1972 Gell-Mann and others formulated "a definite quantum field theory of quarks and gluons" which Gell-Mann named quantum chromodynamics (QCD). In 1992 Evan Ragland proposed a logical extension of the Mayer-Jensen Shell Model as an Alternate Model to the Standard Model of the nucleus.[9]

These highlights sketch a history of the first century of the nucleus. They illustrate the guiding principle of Neils Bohr, that no idea, theory, or thought is complete, perfect, or everlasting but each is an important step to our better understanding of nature. The issues argued later herein contrast different concepts of the constitution of matter and the forces acting on matter. They conflict, quarks and gluons versus fundamental electrons and protons and composite neutrons and atoms. Hopefully the arguments are careful, fair, simple, and properly illustrated.

Neutron Capture and Nuclear Constitution

Neils Bohr depicted and elucidated his new views on neutron capture and nuclear constitution to the Chemical and Physical Society of University College London on February 11, 1936 using the illustration reproduced in Figure 1.[3] The pictured billiard balls resting in a shallow basin represent the free protons (dark) and neutrons (lighter) of a nucleus. The shallow basin represents the strong force of the nucleus, which holds the protons and neutrons (nucleons) together.

Bohr first sought to convey that a neutron struck so as to

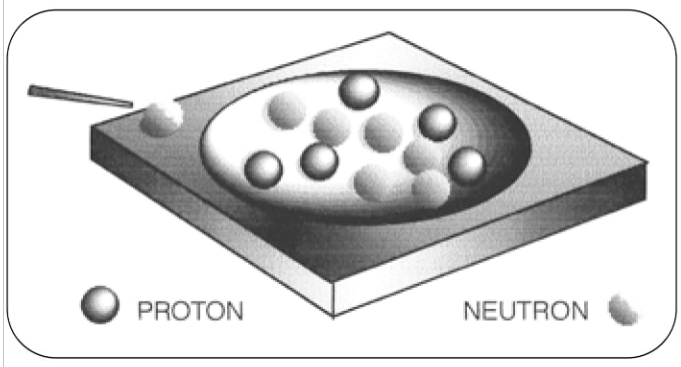

Figure 1. Bohr model of the compound nucleus - February 29, 1936.

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cross the basin would pass down one slope, up the other, and depart with its original velocity, *if the basin were empty*.[5] If the basin were not empty the neutron would collide and impart some portion of its energy to a nucleon, which would join in imparting energy to other nucleons; this process would continue in like manner until the original kinetic energy was distributed among all the nucleons in the basin. If this process were loss less it would continue until sufficient energy to escape were imparted to some nucleon near the outside. Bohr portrayed with this illustration: ". . . that for some times afterwards no single particle will possess sufficient kinetic energy to leave the nucleus."

More discerning was Bohr's insight that ". . . it is therefore clear that the duration of the encounter [neutron capture] must be . . . long compared to . . . the time . . . the neutron . . . [uses] . . . passing through . . .nuclear dimensions." Then he presents his principle issue: "The possible later . . . ejection of a material particle, or in its passing with emission of radiation to a final stable state must be considered as *separate competing processes which have no immediate connection with the first stage of the encounter.*"

His presentation was classic Bohr: generalized but *ad hoc*; visionary but simply pragmatic; nevertheless, always directed to the urgent need to know; to the right answer. Never mind that many issues remain unresolved; someone must pick up a saw and start sawing if the house is ever to be built.

One issue that still remains is the nature of the nuclear strong force. Again, with reference to the illustration, protons don't stay together because of gravity. A most detailed examination and discussion of this issue follows.

The Cluster Model of the Nucleus

Neils Bohr restrained his 1936 paper and lectures to general principles, but had George Gamow's 1928 liquid drop model in mind. He thought the physics of "fluid surface tension" might explain the mechanism of the nuclear strong force. He published a discussion of that model in 1937.

Surface tension derives from the fundamental notion of molecular attraction—that molecules tend to stick together. Bohr suggested the strong force was similar to surface tension, but there the analogy ended. Electrical repulsion of protons contradicts the notion of molecular attraction. Nevertheless, the liquid drop model proved useful and scientists seized upon the clump representation of the nucleus.

In Bohr's liquid drop model the nuclear strong force equalizes the electrical repulsion of the nuclear protons. This gives the nucleus a fluid quality. Balanced forces form the nucleon cluster into a perfect sphere, as pictured in Figure 2. Outside forces disturbing this balance may excite nuclear energy exchanges and energy level changes. Classical surface tension explanations can help explain these intricate energetic nuclear phenomena. But the contradiction of attraction and repulsion kept the idea that protons and neutrons were not simple particles.

Figure 2. Nucleons.

Inspection of the nucleus illuminates the complexities of a droplet of free nucleons. Proton to proton, proton to neutron, and neutron to neutron relationships are immediately observed. As there is no way to avoid proton to proton neighbors, it is reasonable to assume the strong force is electromagnetic in character. This of logical necessity imputes electromagnetic properties to the neutron. So the concept that the proton and neutron are simple particles is and was troubling.

Figure 3. Nuclear shell model.

The Nuclear Shell Mode

In 1949 Maria Goeppert-Mayer and Hans Jensen proved the nuclei, hydrogen through uranium, evidenced periodic properties similar to the Mendeleev periodic system of atomic elements. They identified neutron and proton shell structures each with the capacity of 2, 8, 14, 20, 28, 50, 82, and 126 particles.[7] The shell model postulates individual nucleons in well-defined orbits characterized by orbital angular momentum, by a radial momentum, and the one-half spin momentum of the nucleon.

Wolfgang Pauli's exclusion principle applies to both protons and neutrons and to both separately. Thus, there are two shell systems, one for protons and one for neutrons, overlapping one another. In either system a given energy state can hold two neutrons of opposite spin or two protons of opposite spin. Figure 3 shows a typical nuclear shell drawing in which lighter proton shells and darker neutron shells overlay one another. Dots inside each shell indicate nucleons. The inner shell pair are **1s** nucleons; the next pair are **1p** nucleons; and the outer pair are **2s** nucleons.

By 1949 it was clear that the free nucleons (protons and neutrons) of the droplet model and rigorous assigned states of nucleons in the shell structure represented contradictory nuclear constitutions.[10] In 1950 James Rainwater postulated a quasi-empirical nucleus in which a spherical core of all nucleons provided a potential well for odd particle analysis. In 1952 Aage Bohr and Ben Mottelson proposed a "collective model" combining facets of the droplet and shell models. Others (W.A. Hardy and C.H. Townes in 1952, J.A. Wheeler and D.L. Hill in 1953, W. Heisenberg and W. Pauli in 1953) addressed the issue of nuclear constitution.[7,11] None explained the nuclear strong force beyond the surface tension tenet. Thus, conceptual ideas remained in flux and undecided throughout the 1950s and into the early 1960s.

The Quark Gluon Model

Quantum Chromodynamics - QCD

In 1963 Murray Gell-Mann "proposed the existence of quarks," subnucleon fractional charges "permanently confined in some way" inside protons and neutrons.[12] In 1972 Gell-Mann and others formulated "a definite quantum field theory of quarks and gluons" which Gell-Mann named quantum chromodynamics (QCD). Gluons are insensitive to charge but are agents for "exchange of another very different quanta called color." *Color* is the strong force "gluing" quarks together. QCD remains an unproven theory and the questionable reality of *quarks* and *gluons* persists.[13,14]

Proton and Neutron with Quarks

Quarks, forever confined within protons and neutrons,

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have charges of +2/3 e or -1/3 e. Up quarks are +2/3 e, down quarks -1/3 e. The proton is made of two *u* and one *d* quark, the neutron one *u* and two *d* quarks. This makes the proton charge +1, the neutron charge 0. Quarks come in six *flavors*, up and down, strange and charm, and top and bottom. There are also six antiquarks of antiflavor.

Proton and Neutron with Gluons

Basic quark colors—red, blue, and yellow—average out to white. Only white particles are directly observable in the laboratory, so quarks cannot be directly detected. There are eight different gluons for different color situations. Gluons may bind together to form a neutral-colored particle of pure glue called a glue ball.

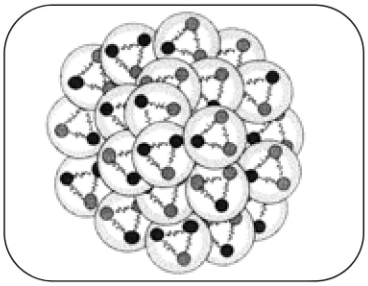

Figure 4. Quarked calcium nucleus.

QCD Complexity

A calcium nucleus is "quarked" in Figure 4. Analysis requires massive computations called lattice QCD. Lattice QCD, even on super computers, is limited to simple QCD models of billiard balls and globs of electrification.

Alternate Model

Assumptions

In postulating mechanisms explaining natural behavior of Nature's phenomena, one makes arbitrary assumptions of the correct questions to ask and anticipates the correct answers.[12] The Alternate Model postulate assumes: the "Big Bang" theory; an expanding space; the equivalence of mass and energy ($E = mc^2$); an electromagnetic field permeates space; space is a surface effect; time flows out; that a system left alone will spontaneously attempt to rearrange itself in the direction of lower energy,[15] etc. Detailed discussion of the assumptions follows.

The "Big Bang" and Space-Time

Nuclear level interactions involve energy, mass, time, and fields which are related in space-time.[13,16] Either a "closed," "open," or "flat" space expanding from the original "Big Bang" is assumed. Further, it is assumed the universe is a surface phenomena of space, *i.e.* assuming perfect expansion and no anomalous events, the history of the universe is simply a pristine expansion of surface, two space dimensions expanding in time. Since the observed universe is irregular and time progresses steadily, it is assumed universal time is pristine and space suffers surface irregularities, *i.e.* disturbance displaces surface moments toward the past or future. Displacements add the third dimension to space and—it is further assumed—also accumulate mass.[17,18]

The Electromagnetic Field and Space

Electromagnetic waves are compression and rarification of electromagnetic flux propagating in space. Thus, it is assumed that an electromagnetic field permeates all space. The magnetic permeability and electrical permittivity of pristine space are isotropic. Permeability is the ratio of magnetic flux to electric current; permittivity is the ratio of electric charge to electric flux. In pristine space there are no differences to cause flux; in real space where there are differences, there is electromagnetic flux.

The Equivalence of Mass and Energy ($E = mc^2$)

Albert Einstein's famous equation, $E = mc^2$, relates the equivalence of energy and mass and assumes no action in space exceeds the speed of light.[18] From this it is further assumed that mass is a state of energy that is "frozen" in time.

The Logic of the Alternate Model

The logic of the Alternate Model constructs the neutron as the complement of the hydrogen (protium) atom, *i.e.* an electron captured inside a proton. The neutron's resultant internal field is the nuclear strong force. According to this model the nucleus is a concentricity of individual proton and neutron fields, each confined to a distinct shell location by wavelength, angular, and spin momenta. The structure conforms to the Pauli exclusion principle, the principles of quantum mechanics[6], and with the exception of the protium nucleus is bound together by neutron(s) internal field(s).

Alternate Model Proton and Electron

Mass: Postulated and Observed

The Alternate Model postulates the proton and electron to be fundamental elements, soliton in nature—artifacts of anomalous disturbances of energy in time. The neutron and hydrogen protium atom are composites of the proton and electron. All more massive nuclei are composites of the proton and neutron. All atoms are composites of nuclei and atomic electrons equal in number to nuclear protons.

An electron is the artifact or scar of energy remaining after energy, "ahead in time," almost equates to coordinate system time. As there is some minimum increment or quanta, which in escaping reduces the anomaly to zero state, all energy ahead in time cannot be equalized. This increment of energy "frozen in time" is the electron mass and can never be returned to coordinate system time. The direction of energy "out to the coordinate system," is the electrical charge, -e. The time lapse for frozen energy along any radius is near C/2 (one-half the speed of light). This causes electron mass to spin. Spin direction may be either right or left. The electron is the least quanta of mass spinning on a *far-out* radius.

A proton is the artifact or scar of energy remaining after the anomaly of energy, "behind in time," draws energy from isoelectric space to equate with coordinate system time. As there is some minimum increment or quanta of energy which cannot be drawn from the system, the anomaly cannot be completely equalized. The accumulation of energy "frozen in time" is the proton mass and can never be returned to coordinate system time. The direction of energy "in to the coordinate system," is the electrical charge, +e. The time lapse for frozen energy along any radius is near C/2. This causes proton mass to spin. Spin direction may be either right or left. The proton is all but the least quanta of mass, piled up near center, spinning on a close-in radius.

This theoretical picture of the proton agrees favorably with the physical shape and charge distribution of the proton measured by Robert Hofstadter of Stanford University in the 1950s. Hofstadter measured the proton radius to be 2.8 x 10^{-13} centimeters[1], with the charge (frozen mass) piling up at the center and fading out at the edges. Similarly, the "classical radius of the electron," calculated theoretically on the assumption that its measured mass is entirely due to the

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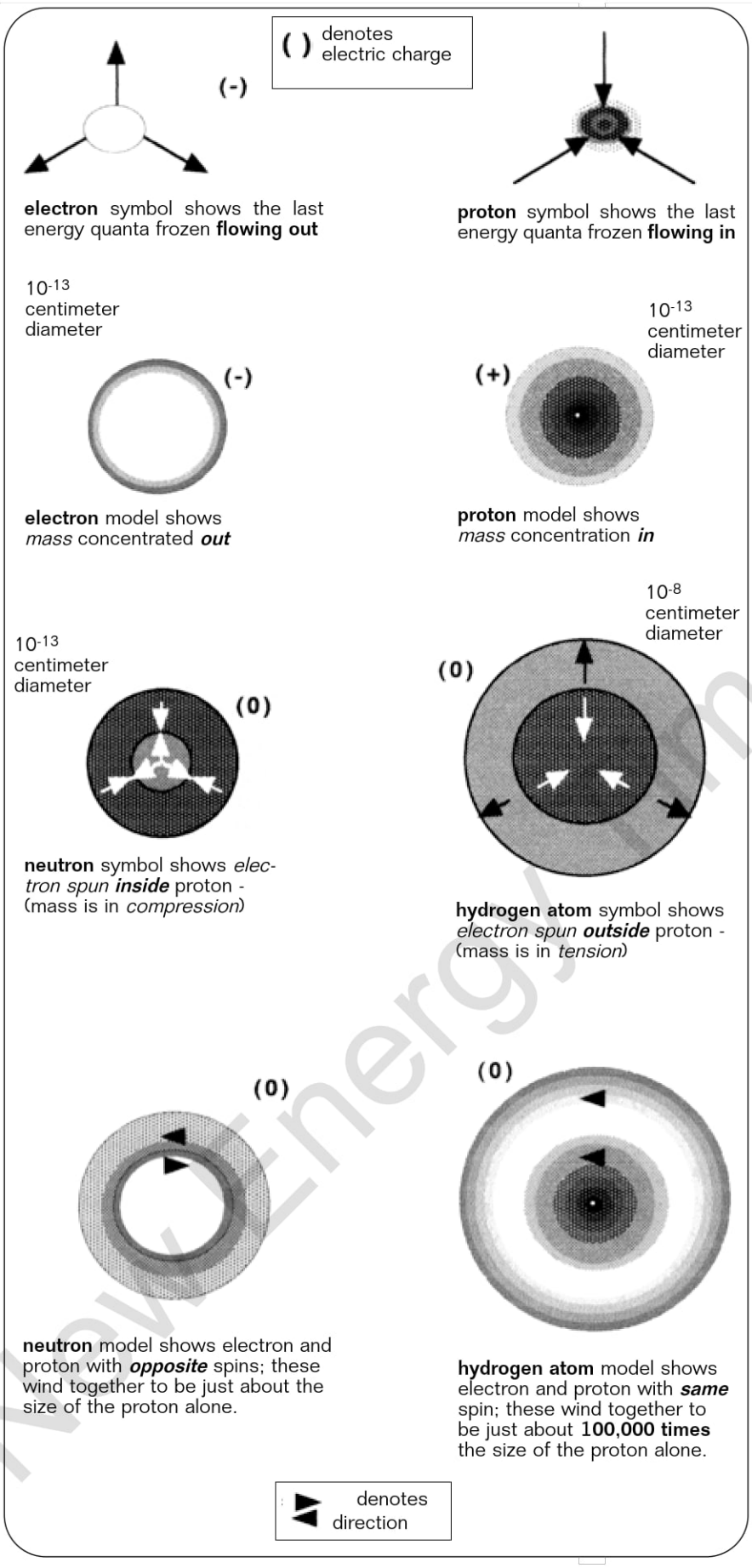

Figure 5. Alternate Model spin and charge symbology.

electrostatic field surrounding it, is 2.8 x 10^{-13} centimeters.[6] Precise measurement of the electron radius is in almost exact agreement with this classical calculation. Hofstadter was awarded the Nobel Prize in 1961 for his "photograph" of the proton.

Alternate Model Spin and Charge Symbology[20]

The Proton and the Electron

The Alternate Model postulates that the mass of the proton forms from energy "frozen" flowing inward to the center and the mass of the electron forms from energy "frozen" flowing outward from the center (electrostatic zero) of the fields. The top of Figure 5 schematically illustrates this concept. Arrows show the direction of energy flow for the electron and the proton. The electron symbol shows the last quanta of energy "frozen" flowing out; the proton symbol shows all but the last quanta of energy "frozen" flowing in. The second row in Figure 5 illustrates the dense mass of the proton close to center and the skimpy mass of the electron far from center. Thus, the electron is a tiny mass spinning about a large radius and the proton is a large mass spinning about a tiny radius.[13,21]

The Neutron and the Hydrogen Atom

The Alternate Model holds that *the proton and electron are fundamental entities* and that the neutron and the hydrogen (protium) atom are proton and electron constructs in electric charge and spin. Symbolic representations of the neutron and hydrogen atom are shown in row three in Figure 5. The neutron symbol shows an electron spun *inside a proton of opposite spin*. Neutron mass is in compression. The hydrogen atom symbol shows an electron spun *outside a proton of the same spin*. The atomic mass is in tension. In the bottom row the neutron model shows an electron and proton of opposite spins wind together to be near proton in size. In the hydrogen atom model an electron and proton of like spins wind together to be near 100,000 times the size of the proton alone.

Summary of Characteristics

Proton energy presses inward and mass piles up near the center; electron energy escapes outward and only a remnant of mass remains trapped far from center. The neutron is an electron trapped inside a proton. The hydrogen (protium) atom is an electron captured outside a proton. The neutron can be viewed as in compression, the protium atom as in tension.

Alternate Model Uniqueness

Half-Shell Model Diagrams

It is difficult to visualize the strong force using clump and shell model diagrams.

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The half-shell diagram (Figure 6) of concentric nucleon shells aids discussion of nuclei and visualization of the strong force. Ensuing discussions use these diagrams.

The Crucial Issue

The crucial issue in the Alternate Model hypothesis is the structural concept of the neutron, the concept that the neutron is the symmetrical complement of the hydrogen protium atom—an electron spun inside a proton. There is other plausible evidence supporting this concept. 1) The neutron decays into a proton, electron, *and neutrino*; the latter a part of the "yet to be explained" nature of the nucleus. 2) The neutron has a magnetic moment whose direction is opposite to that of its spin, as if a negative electric charge were revolving in the spinning neutron. This negative magnetic moment accounts for the stability of the deuteron (H^2); "one" nuclear proton **1s** inside the shell of "one" nuclear neutron **1s**. And also, the decay of the triton (H^3); "one" nuclear proton **1s** inside the shells of "two" nuclear neutrons *1s* and **1s**; (the notation *1s* in italic indicates left spin, **1s** in plain type indicates right spin) which decay into (He^3), "two" nuclear protons *1s* and **1s** inside the shell of "one" nuclear neutron *1s*. Thus, through secondary mechanics, the neutron contributes negative magnetic moment along with neutrally charged mass to the nucleus.

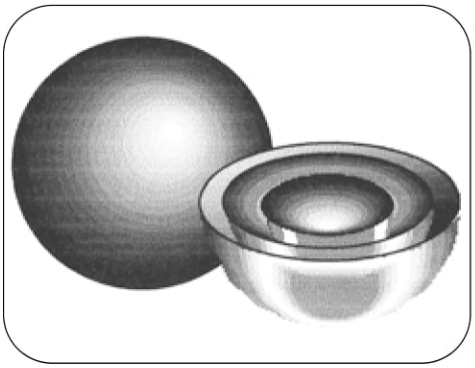

Figure 6. "Half-shell" concentric nucleon.

The "Yet to be Explained"

According to the Alternate Model, the electron spinning inside a proton contributes negative magnetic moment to the resultant neutron field. This action overcomes and reverses proton spin momentum. As momentum reverses, virtual energy is absorbed from the isoelectric field of space *as proton mass moves through zero state* relative to coordinate system space time. Because of this additional energy the resultant neutron is unstable and shortly decays back into a proton, an electron, and returns the absorbed energy to coordinate system space time.

Nuclear Stability

A neutron field may become stable when bound with a stable field. As example, the proton is a stable field in coordinate system time. A neutron and host proton with the same spin direction may bind together electrically and spin together concentrically about the host proton. The result is a stable nucleus, the deuteron. The deuteron may acquire a second neutron of spin opposite to that of its inner (original) neutron component. The result is a triton nucleus, in which mass remains ahead in coordinate system time, thus the triton nucleus is unstable. Ultimately the triton inner neutron decays to a proton having opposite spin to the host proton, emits an electron, and returns absorbed energy to coordinate system space time. The triton decay is into a stable helium-3 nucleus. The helium-3 nucleus may acquire a second neutron of spin opposite to that of its neutron component. The result is a stable nucleus, helium-4.

Alternate Model Diagrams

Magnetic Moment

Magnetic moment results from vibrational motion of the electron about the atomic nucleus and from the electron's inherent spin. The Bohr magneton, the electron's magnetic moment, is the established unit of measure for intensity of magnetic field. One Bohr magneton is equal to 1,840 nuclear magnetons. The electron's magnetic moment is negative. The spinning proton has a positive magnetic moment whose value is 2.79 nuclear magnetons. The neutron has a negative magnetic moment of 1.93 nuclear magnetons as if a negative electric charge revolves in the spinning nucleon.

Electron Half-Shell Model

The electron is a stable, subatomic, negatively charged (-e) entity with a rest mass of 9.1066×10^{-28} gram. *The electron is fundamental; it is a whole object and cannot decay into lesser parts*. Figure 7 shows an electron spinning clockwise. The electron's magnetic moment value is 1,840 nuclear magnetons. The tiny mass of the electron distributes on a mean radius far from the electron's center of rotation. The center of the electron is void, zero state.

Proton Half-Shell Model

The proton is a stable, subatomic, positively charged (+e) entity with a mass 1,836 times that of the electron. *The proton is fundamental; it is a whole object and cannot decay into lesser parts*. It is the nucleus of protium, the regular isotope of hydrogen. The middle half-shell diagram in Figure 7 shows a proton spinning counter clockwise. The spinning proton has a positive magnetic moment whose value is 2.79 nuclear magnetons. Proton mass 1.67×10^{-24} gram concentrates near the proton's center of rotation. As a result the proton's magnetic moment is small compared to the electron's magnetic moment of 1,840 nuclear magnetons. The diagram cut away section exhibits mass density and radial vibrational nodes. The center of the proton is zero state, a void.

Neutron Half-Shell Model

The neutron is an unstable entity with a mass 1,839 times that of the electron. It has a magnetic moment whose strength is 1.93 nuclear magnetons and whose sign is opposite that of the proton. This means that the magnetic properties of the neutron are those of a rotating negative charge. *The neutron is a construct of an electron spun inside a proton; it can and does decay into a proton and electron*. The rightmost half-shell diagram in Figure 7 shows a neutron construct in which the clockwise spin electron is spun inside the counter clockwise spin proton. This action overcomes and revers-

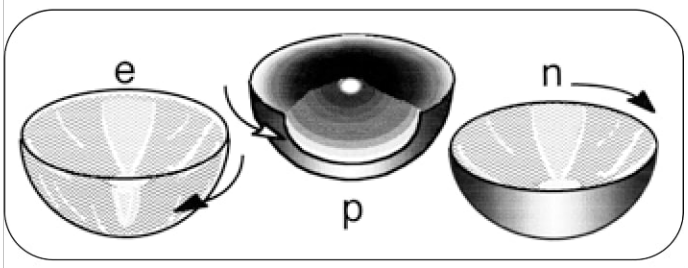

Figure 7. Electron, proton, and neutron.

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es proton spin momentum. As momentum is reversed virtual energy is absorbed from the isoelectric field of space *in moving proton mass through zero state* relative to coordinate system space time. Absorption of this reactive energy makes the free neutron unstable and it soon decays back into a proton, an electron, and returns the absorbed energy to coordinate system space time. The center of the neutron is void. Electron absorption presses proton mass outward.

Deuteron Half-Shell Model

A deuteron is created when an unstable neutron binds to a stable proton. Figure 8a depicts a deuteron constructed of a neutron and host proton of like spin bound magnetically and spinning concentrically about the host.

The neutron magnetic moment is negative; the proton is positive. The deuteron magnetic moment is positive, almost the sum of the magnetic moments of its constituent neutron and proton. The deuteron is stable because: 1) the positive proton magnetic moment overcomes the neutron negative magnetic moment; 2) the neutron's electron component and the host proton attract electrically; and 3) the neutron's proton component is opposite in spin to the host proton. The latter, complementary (180°) spin relationship, binds the host proton and the guest neutron tightly together. Both the proton and the neutron occupy the lowest energy levels, **p1s** and **n1s** respectively. Thus, deuteron mass is less than the sum of the free neutron and free proton masses. The lost mass transmutes to gamma ray emission of energy (2.2 MeV) in accordance with Einstein's equivalence of mass and energy.

Triton Half-Shell Model

A triton is created when a second neutron binds to a stable deuteron. Figure 8b depicts a triton constructed of two neutrons and a host proton. The two neutrons are of opposite spin, cancel one another magnetically, and spin concentrically about their host at the lowest possible energy level, **n1s**. The complementary (180°) spin relationship between the proton component of the inner neutron and the host proton at energy level **p1s** binds the host proton and inner neutron tightly together. The two neutrons are less tightly bound by their complementary spins at energy level **n1s**. The triton's magnetic moment is positive, about 7% greater in magnitude than the host proton's magnetic moment. In the described example of fusion of a neutron and a deuteron, the resultant triton mass is less than the sum of the free neutron and free deuteron masses. The lost mass transmutes to gamma ray emission of energy (6.2 MeV) in accordance with Einstein's equivalence of mass and energy.

Visualization

Visual insight can be drawn from shell diagrams. The deuteron's magnetic moment is almost the sum of the like spinning but opposing magnetic moments of the neutron and proton shells. But the triton does not become more negative, as summing might suggest; rather, it becomes more positive—in fact, slightly more positive than its single proton. The reason is: magnetic moments of the two counter spinning neutrons cancel. A pattern of odd-neutron-negative magnetic moment, odd-proton-positive magnetic moment persists in light nuclei. Indeed, it is an important factor throughout the full range of elements. Also apparent from Figure 8 is that neutron internal electrical polarities alternate as neutron shells form one upon another.

Helium 3 Half-Shell Model

Tritons decay to helium-3 nuclei. As already noted the triton's inner neutron is tightly bound to the host proton by the complementing intrinsic spin of the neutron's proton component. This bond is sufficient, from time to time, to overcome the bond between the two triton neutrons. When the latter bond breaks the inner neutron decays into its component parts, an electron and a proton. The dissociated proton, of opposite spin to the host, joins the host proton in energy level **p1s**. The freed electron and a neutrino exit the nucleus. Decay of the inner neutron into a proton transmutes, a triton into a helium-3 nucleus. Figure 9 shows a helium-3 nucleus.

The magnetic moment of helium-3 is -2.127 nuclear magnetons. The magnetic moments of the protons cancel leaving the helium-3 nucleus the negative magnetic moment of the single neutron. In fact, the helium-3 nucleus magnetic moment is slightly more negative than the moment of its single neutron.

Helium 4 Half-Shell Model

Figure 9 illustrates the helium-4 nucleus. When a fourth particle, the neutron n_3, attaches to the helium 3 nucleus a huge binding energy (20.6 MeV) is released as a gamma ray. The total binding energy of the two protons and two neutrons in the resultant helium 4 nucleus is 28 MeV. Great stability arises from this large binding energy. The helium 4 nucleus is the α particle.

According to the Pauli exclusion principle, nucleons at the same energy level must differ in charge or spin or both. A nucleon can take two spin values and two charge values (0 for a neutron and +1 for a proton) and therefore four nucleons may occupy the same energy level. The helium-4 nucleus with two protons and two neutrons at ground state **1s** is zero in charge, spin, and magnetic moment. There is no way to attach a fifth nucleon to the helium-4 state, closed as it is, in spin, charge, and magnetic moment. The next energy level pair, taking six nucleons each, are **1p** shells.

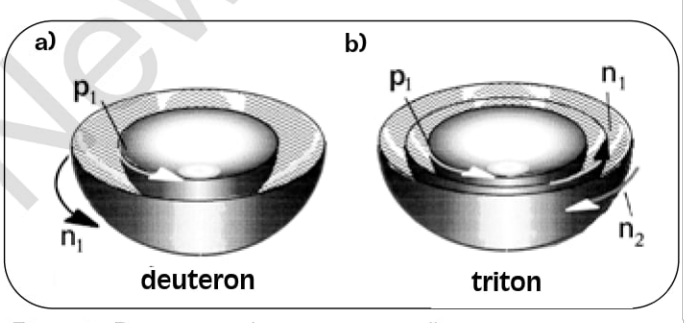

Figure 8. Deuteron and triton cut-away illustration.

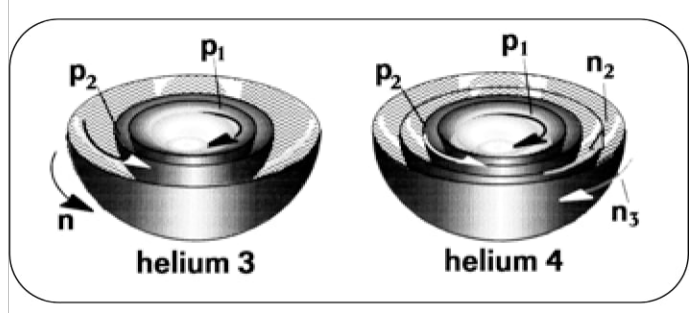

Figure 9. Helium 3 and helium 4 cut-away illustration.

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Alternate Model Charge/Spin Table

Fundamental Elements and Constructs

The Alternate Model postulates the proton and electron are fundamental elements, soliton in nature, artifacts of anomalous energy disturbances in time. The neutron and the hydrogen protium atom are constructs of the proton and electron. All more massive nuclei are constructs of protons and neutrons. All atoms are composites of nuclei and atomic electrons.

Electron/Proton Charge/Spin Table

Figure 10 shows sixteen possible combinations of protons and electrons in charge and spin. This table, sometimes called a truth table, lists the four possible proton and electron spin states both across the top and down the left side. The construct of every possible combination is shown in the squares. There are four zero or excluded states, four neutron states, four hydrogen states, two double proton states, and two double electron states.

Arrows indicate the spin of each construct. Two neutrons are of left spin, two are of right spin. Neutron spin is in the direction of the electron parent. All neutrons have a charge of zero. Two hydrogens are of left spin, two are of right spin. The hydrogens have a spin of one, always in the direction of the parents. All four hydrogens have a charge of zero. The double protons cancel one another in spin and have a charge of +2e. The double electrons cancel one another in spin and have a charge of -2e.

This table demonstrates the proton and electron are the exclusive, fundamental building blocks necessary for construction of the entire Mendeleev system of elements.

Comment

When I thought to write about the nucleus I could not help but recall a small book in my library, *Thirty Years That Shook Physics: The Story of Quantum Theory*, by George Gamow. Gamow wrote this fine little book in 1965 and commented in closing:

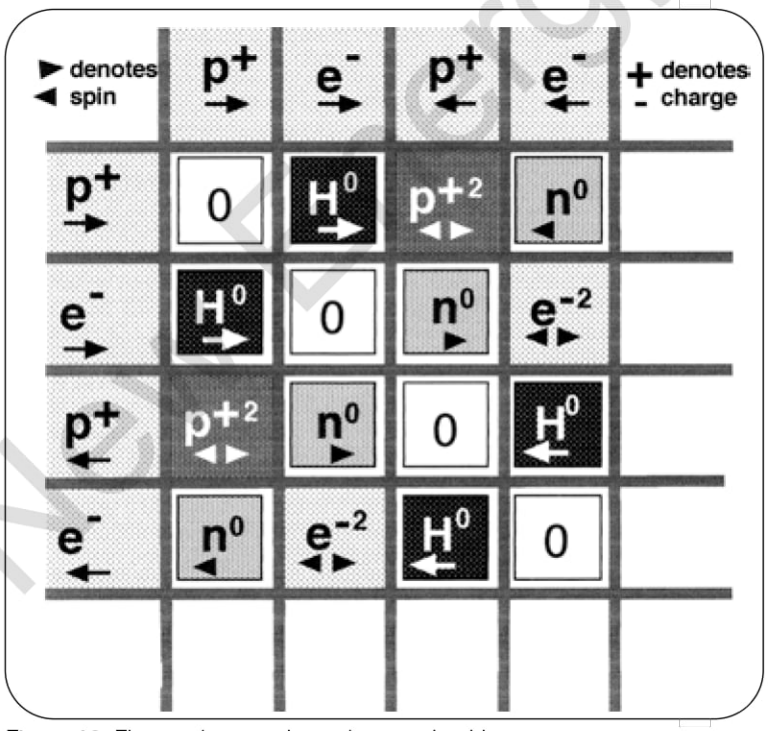

Figure 10. Electron/proton charge/spin truth table.

> But, after thirty fat years in the beginning of the present century, we are now dragging through the lean and infertile years, and looking for better luck in the years to come. In spite of all the effort of the old-timers like Pauli, Heisenberg, and others and those of the younger generation like Feynmam, Schwinger, Gell-Mann, and others, theoretical physics has made very little progress in the last three decades, as compared with the previous three decades.

And he continued after referring to a letter from Wolfgang Pauli:

> Seven years have passed since this letter was written, hundreds of articles have been published on the problem of elementary particles, and still we are in darkness and uncertainty on the subject. Let us hope that in a decade or two, or, at least, just before the beginning of the twenty-first century, the present meager years of theoretical physics will come to an end in a burst of entirely new revolutionary ideas similar to those which heralded the beginning of the twentieth century.

Gamow's lament of 1965 haunts physics. As the new century begins, only Murray Gell-Mann and dedicated disciples of Quantum Chromodynamics (QCD) profess to understand the nuclear strong force. QCD for all its imaginative structures and disembodied tenets serves only the doctrine of particle physics,[22,23] and neglects practicality and necessity for broad understanding. Scientific tyranny is not new. Louis de Broglie noted years ago that, "The advances of science have always been frustrated by the tyrannical influences of certain preconceived notions that were turned into unassailable dogmas, and for that reason scientists must periodically re-examine their basic principles."

Nuclear theory must be re-examined. The legacy of QCD constrains the best and brightest minds to a capricious, ever narrowing and over quarried path of discovery.[24] The next generation can waste a lifetime wandering this pathway. While QCD presently is dominant dogma, the *quark-gluon* era of inventive discovery was over by 1980.[25] Many in the scientific community dislike the symmetry breaking and gadgetry of QCD but the nucleus doesn't directly affect most science, and so long as the clumped model of the nucleus prevails no critic has a better solution. The problem is the clump model which dates back to 1936. We have known it was inadequate since 1949. It's time to revisit the problem with commitment to sensible solution. Without a renaissance of fresh ideas nuclear technology will remain stalled for another half century. Fortunately, as the architects of QCD age, the scene becomes more conductive to new ideas and youthful challenge.

I have held strong alternative nuclear concepts for several years. Contemplating writing this, I questioned if my ideas deserved the light of day. After writing, I am convinced for strong reasons that they do. One conviction arises from the intimacy of close historical review of how atomic and nuclear theory developed. Bold ideas and concepts, candidly and freely exchanged, distinguish the early years of atomic physics. Just reading Bohr leaves one believing that *no idea, theory, or thought is complete, perfect, or everlasting but each is an important step to our better understanding of nature.*

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Another dilemma was where to start. Should one start with John Dalton's solid billiard balls of matter or J.J. Thompson's electron and atomic model enriched by Planck, Einstein, Rutherford, and Bohr? I chose to start with Neils Bohr's landmark paper "Neutron Capture and Nuclear Constitution" published in *Nature*.[5] This bold paper is the fountainhead of all contemporary nuclear concepts.

I have endeavored to write in general terms for a broad audience, omitting mathematical arguments and relying heavily on illustration. At the same time I have tried to be sufficiently methodical for rigorous peer review. As a result, almost every paragraph is an exercise in compromise. By presenting separate discussions, each accompanied by illustrations, I have tried to communicate the essence of my arguments. I hope these pages contribute to the openness of nuclear theory and are a step toward better understanding of nature.

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About The Author

Evan Ragland graduated from the U.S. Navy Electronics School in World War II, received a BSEE from Mississippi State University in 1949, attended the University of Michigan summer session on computers in 1955, and graduated from Lake Forest University Graduate School of School of Management in 1962. He was born January 7, 1927 and is widowed. His son, two daughters, their husbands, and three grandchildren all live in California.

Mr. Ragland has practiced engineering since 1949 and has been in the computer industry since the early days of Illiac, Maniac, Whirlwind, and Univac. From 1949 through 1968 he was on the research staffs of Victor Comptometer, Motorola, and Singer. In 1968 he founded Regitel Corporation to develop computer point-of-sale and credit transaction systems for most of the major department stores in America. His principal contributions to the industry have been development of computer-related technology and systems. Three of the most far reaching are: digital-to-voice conversion, which is the genesis for telephone answering, the Regitel point-of-sale system, which he pioneered, and the Daisy Wheel Printer, which he originally developed.

Mr. Ragland holds eight U.S. and a number of foreign patents and is the author of numerous technical papers. From 1961 to 1964 he served on the Advisory Council to the Motorola Board of Directors. His original Daisy Wheel Printer is in the National Museum of American History, Smithsonian Institution.

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"The advances of science have always been frustrated by the tyrannical influences of certain preconceived notions that were turned into unassailable dogmas, and for that reason scientists must periodically re-examine their basic principles."

—Louis de Broglie

"It is the glory of geometry that from those few principles, brought from without, it is able to produce so many things."

—Isaac Newton

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Transforming the Planet with a Zero-Point Energy Experiment

Moray B. King*

Abstract

A review of some of the best "free energy" inventions of the past twenty-five years, viewed with the hypothesis that charged clusters couple to the zero-point energy, yields sufficient insight to construct a free-running energy demonstration device. The discussion includes Papp's noble gas engine, Gray's pulsed capacitor discharge motor, Graneau's electric discharge water explosions, Correa's pulsed abnormal glow discharge plasma tubes, Brown's nuclear battery, Hyde's electric generator, Sweet's conditioned barium ferrite, light water "cold fusion" experiments, and Shoulders' charge cluster research. Combining their research reveals a pattern giving the underlying principle for building a self-running device.

Introduction

Can the zero-point energy (ZPE) be tapped as a substantial energy source?[1] The answer depends on the physical nature of the vacuum fluctuations, a topic that begets considerable scientific controversy. The ZPE was first discovered by quantum mechanics as a term in the equations modeling an ever present quantum jitter yielding the uncertainty principle. Quantum electrodynamics (QED)[2] describes it as high frequency, energetic concentrations of electric field energy sufficient to manifest short-lived (virtual) pairs of elementary particles that spontaneously pop in and out of existence. This activity constitutes the substrate of pure empty space. Western academic thought groups into essentially three points of view regarding the paradigm of what constitutes empty space: 1) Space is a void with the ZPE just a mathematical fiction that does not physically exist, 2) only an inconsequential low level ZPE physically exists, or 3) substantial energy is truly present. There is a paradigm conflict between the various schools of thought. The spirit of the Copenhagen interpretation of quantum mechanics represents the first group where the ZPE is to be "renormalized" away without any attempt at interpreting what is underlying the mathematical model. The second group introduces an artificial, high frequency "cut-off" in the equations of the ZPE to limit how much energy can be present, but such a cut-off would then eliminate the energy densities needed for virtual particle pair production, the basis of QED. The third group can argue that the ZPE cannot be tapped appreciably because we have no practical means to interact with the high frequency components, or that the ZPE action is chaotic and it would be an entropy violation to tap it. The last objection can be met via Prigogine's[3] Nobel prize contribution to thermodynamics where he shows how chaotic systems may evolve toward self-organization. Whether a system can be invented to interact with the high frequency ZPE modes[4] puts the debate in the realm of engineering.[5] There is one thing for certain: the only convincing proof that the ZPE can be tapped as an appreciable energy source can only come from an experiment.

There are severe constraints when it comes to an experiment that violates the reigning scientific paradigm. Kuhn[6] shows in his seminal thesis, *The Structure of Scientific Revolutions*, that paradigm-violating experiments are not welcomed by the scientific community, and often the scientific method regarding their investigation is suspended. Instead political and sociological factors dominate the behavior of the majority of scientists. Typically the experiment is ignored. Rubik[7] has extended Kuhn's thesis to modern times, indicating that if a paradigm-breaking experiment threatens entrenched economic interest as well, there can be a severe and even ruthless suppression of the evidence if the experiment were to begin to successfully replicate. A recent example is the cold fusion class of experiments. Here ridicule is applied, patents blocked, government grants withdrawn, and jobs threatened just over a scientist's willingness to investigate a phenomena that has been replicating worldwide as an "underground" activity. If an inventor is lucky (or perhaps unlucky) enough to stumble upon an energetic effect reliable enough to allow the manufacturing of a practical "free energy" machine, suppression tactics have been known to occur, such as funding blockage, incessant litigation, patent secrecy orders, personal threats, crime framing, and even assassination. If one wishes to transform the planet with a paradigm-shattering experiment, the key point is to realize that the problem is not a scientific one, but rather a political/economic one. The solution requires completely different tactics than "business as usual."

Kuhn has shown that when the scientific paradigm has changed, it was done by a new generation of scientists willing to study the new phenomena and repeat the anomalous experiments. Thus establishment scientists can be expected to ignore the new phenomena and to ridicule those investigating it. If the experiment begins to replicate, entrenched economic interest can be expected to suppress the discovery. These expectations determine the nature of an experiment that will have a lasting impact.

In particular, the zero-point energy experiment must be:

1) Easy to replicate, so easy that it can be done successfully as a home hobbyist project.
2) Self running. Measurements of excess energy are often difficult and will be criticized by skeptics no matter what.
3) Easy to describe and share. Information can spread rapidly; a device that has a secret operating principle or requires a special kit can be destroyed and its inventor suppressed.

Inventions with Charge Clusters

There have been a number of successful "free energy" inventions that would have breached the market place if it were not for suppression problems. Some might qualify as candidates for easy replication, but most require considerable effort. There is a pattern to many of the inventions which suggests a common hypothesis regarding how they couple to the vacuum energy: Most have produced (sometimes unwittingly) an abundance of charge clusters.[8] Each cluster is a micron size, charged plasmoid resembling ball lightning that coheres the ZPE to yield excess energy. The hypothesis could concisely explain a variety of "free energy"

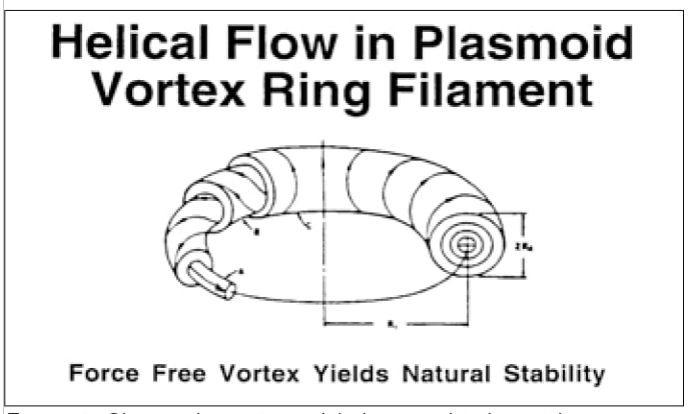

Figure 1. Charge cluster is modeled as a tight plasmoid vortex ring. The thin ring coherently interacts with the zero-point energy and might be the basis for charge formation from the vacuum at a variety of size scales from elementary particles to ball lightning.

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machines if we adequately understood the nature of the charge cluster itself.

The scientific anomaly essentially regards the charge cluster's existence. Shoulders[9] is credited for the discovery of the charge cluster which he named "electrum validum" (EV). He observed the formation of micron size plasmoids with a net charge measured to be on the order of 10^{11} electrons and 10^{6} positive ions. The stability of such a plasmoid is completely anomalous in a classical model because of coulomb repulsion. The best models[10-12] suggest a vortex ring (Figure 1) where an intense toroidal magnetic field causes a tight poloidal spiral (around the toroid) trapping the electrons. Here energy densities similar to a neutron star would be required to compensate the coulomb repulsion. Such energy densities take us out of the classical realm and into quantum electrodynamics where vacuum polarization effects might provide a stabilizing mechanism.[13] The tight toroidal spiral does match behavior often observed in plasma experiments: There is a tendency for plasmas to manifest tight vortex filaments known as the "filamentation instability."[14] Reed[15] shows the vortex matches the force-free Beltrami vortex (Figure 2) where the plasma naturally takes the form of an ever tightening spiral. If such a vortex closes onto itself to make a vortex ring, this tightening tendency propagates around the ring, providing positive feedback which squeezes the ring's poloidal radius smaller and smaller until it reaches the dimensions where the high frequency, high energetic components of the ZPE become active and dominant. Thus the natural behavior of the plasmoid itself solves the engineering problem of manifesting boundary conditions on a small enough scale to couple the short wavelength, high energetic modes of the ZPE into the system. The vortex ring model also offers another insight: It might illustrate the mechanism for charge formation directly from the vacuum and suggests that such formation might occur at any scale producing subquantum unstable particles, electrons, micron sized EV's, and ball lightning.

Creating charge clusters requires precise boundary conditions since a linear vortex filament would not naturally close onto itself. Mesyats[16] has shown that "ectons" (his name for EV's) arise from an explosive discharge from a pointed cathode (or from an irregular defect region on the cathode). The instant before the discharge, a microscopic portion of the cathode melts, and a conical stalk of liquid metal protrudes from it (Figure 3). Symmetrically surrounding the stalk is a layer of glow plasma ionization. The EV is formed when the tip of the stalk explodes, compressing the surface electrons between two perfectly symmetrical, semi-spherical ion layers (one from the tip, the other from the glow plasma). It is the perfect conical symmetry of the liquid stalk that provides the precise boundary conditions needed to form the vortex ring as a single complete entity. Thus EV formation can be enhanced by using liquid metal tip electrodes like Shoulders suggests (Figure 4) or by first inducing abundant cathode glow plasma as Mesyats describes. Forming the liquid or plasma stalk is the key phenomenon that underlies EV creation.

Shoulders suggests two methods for tapping the excess energy from an EV. Either rectify the electric pulse that is produced when the EV hits the anode, or use a pickup coil surrounding a traveling wave tube through which the EV accelerates. Most inventions that have manifested excess energy from plasma EV activity have used the rectification technique. For his 50 KW device, Moray[17] invented special rectifier tubes he called "valves" to store the energetic pulsations from his ion oscillator tubes onto capacitors, which then become the input to the next stage of his device. Correa[18] rediscovered Moray's fundamental operating principle in his pulsed abnormal glow discharge (PAGD) tubes. Here, rectification is used to recharge batteries for over unity power gain. Correa shows how to launch just the spark precursor (which contains the excess energy) and quench the lossy arc that follows by stopping the current flow. Correa limits the current by a resistive feeder circuit, whereas Moray used capacitor discharge to control the feeding current pulses. Correa precharges the plates with glow plasma from a voltage source, whereas Moray used a radioactive cathode to build up glow plasma to trigger it at a lesser voltage. Brown[19] likewise used a radioactive cathode in his resonant nuclear battery, claiming one of the simplest embodiments of Moray's original discovery. Correa's and Brown's inventions are excellent candi-

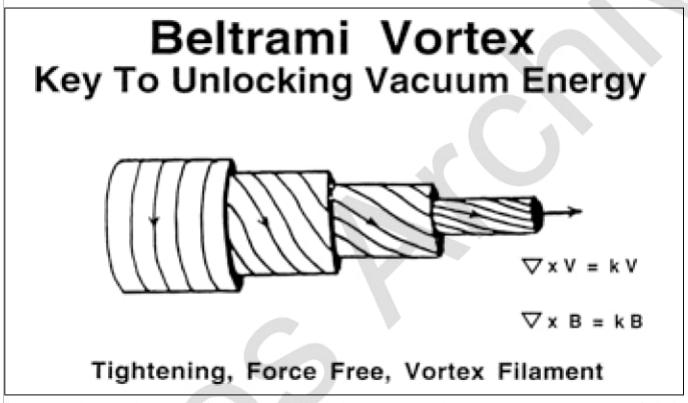

Figure 2. A plasma filament exhibits a natural force-free vortex which tightens because the flow aligns with its own vorticity (curl) vector. The tightening vortex yields an extraordinary energy density at the tip, which activates the zero-point energy.

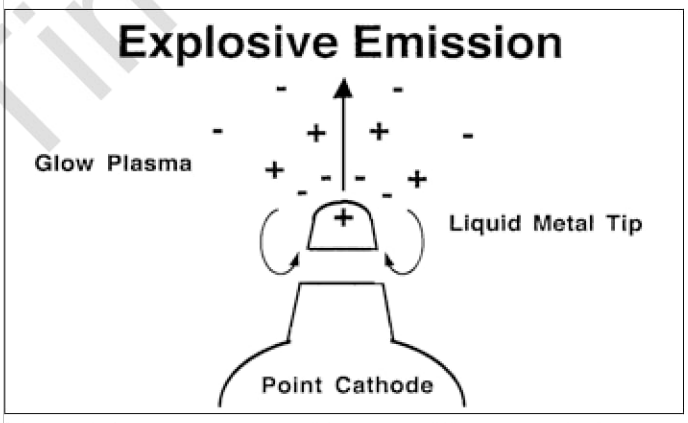

Figure 3. A vortex ring plasmoid is created from an explosive emission from a liquid metal stalk protruding from the cathode. The tip of the stalk explodes into the surrounding glow plasma. The perfect symmetry of this compression event yields a closed vortex filament.

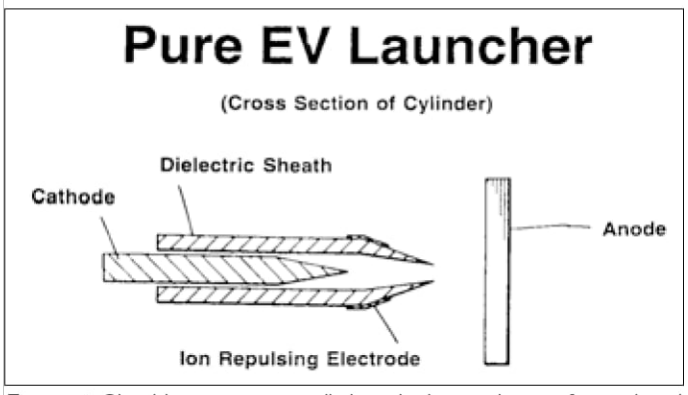

Figure 4. Shoulders can repeatedly launch charge clusters from a liquid metal cathode. The dielectric sheath guides a layer of conductive liquid to the cathode point. An ion repulsing electrode helps to prevent residual ions from contaminating his pure "electrum validum" (EV).

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dates for replication at a university facility.

If every spark, even weak electrostatic discharges, contained an EV precursor, then Wimshurst-like devices that produced a plethora of electric discharge pulses, where each is rectified and capacitively stored, could sum them to produce a surprising energy gain. The Swiss ML converter[20,21] might be based on this principle as well as Hyde's[22] electrostatic field chopper. Hyde might have produced EV discharges across the dielectric separators between adjacent stator segments to produce the ten-fold voltage spike he was observing. Hyde meticulously constructed hundreds of small, voltage step down, rectifier circuits connecting each stator segment to its distant counterpart across the device, and then further summed their output to produce a net 20 KW DC output while self running. That is an extraordinary claim for such a simple device (in principle). If Hyde's claims are true, then mechanical means can be used to induce an abundance of small EV discharges (which are rectified and summed) to yield a powerful and robust energy machine.

Abrupt electric discharges have been observed to produce an anomalous mechanical reaction force. Graneau's[23,24] experiments with capacitor discharge, water arc explosions have demonstrated both excessive force and over unity energy production. He also observed with high speed photography the formation of a ball lightning plasmoid in the chamber associated with the explosive event. It was important to discharge the capacitor rapidly to induce the anomalous event. His experiments showed that with the same capacitor energy if the discharge pulse was not sharp enough, no explosion occurred, and the water simply remained in the chamber. Anomalies associated with the abrupt transition from matter to plasma have also been observed in recent experiments[25] of firing a femtosecond pulsed laser into xenon to produce plasma clusters (or perhaps EV plasmoids) that resulted in anomalously excessive kinetic energy of the xenon ions. Perhaps the most famous energy invention to take advantage of this phenomena is Papp's[26] noble gas engine. Papp filled a mixture of the inert gases into a sealed piston that gets fired with an electric arc (aided by radioactive electrodes). The resulting explosion drove the piston and produced anomalously excessive energy. Papp claimed the inert gas was "the fuel" which never gets consumed. Today the hypothesis is that any abrupt transition from matter to plasma coherently activates the ZPE, and that such transitions are likely to create EV plasmoids. This hypothesis could be the foundation for creating many future inventions that tap the zero-point energy.

A noteworthy invention that may have utilized both the electrical and mechanical energetic aspects of EV's is Gray's[27] pulsed discharge electric engine. Gray energized opposing electric magnets by firing a capacitor discharge across the air gap between pairs of rotor coil magnets and stator coil magnets timed such that pulsed magnetic repulsion would drive the rotor. The circuitry was designed such that the pulse from the capacitor would energize the magnets and then return to a rectification circuit that would recharge the battery. At first analysis, engineers thought that the arcing in the air gap would foolishly produce tremendous losses, but Gray demonstrated with his prototypes that not only did the motor produce a large torque, it ran so efficiently that the windings and motor housing remained cool. For his invention Gray won the Inventor of the Year award in 1976, but he ran afoul of the Securities and Exchange Commission for his claims of over unity efficiency. If every electric discharge across the rotor gap abundantly produced charge clusters, the motor may have actually tapped the ZPE as its energy source. Today, a replication of Gray's invention (as well as Correa's) could use large (*e.g.* one farad) commercial capacitors in place of the batteries to make the device self running.

If charge clusters are a conduit to the vacuum energy, it might be more efficient to trap and couple to them rather than rectify their decay pulse. The phenomena of fractoemission[28] might offer a method where EV's could be created and their energy extracted all within a solid state device. Fractoemission occurs when a crystalline material cracks and forms an anomalously persistent glow plasma in the crack. In some experiments the luminescence has been observed to persist for hours. Fractoemission is likely a small scale occurrence of the same phenomena as earthquake lights, where ball lightning plasmoids are emitted from an earthquake fissure. If fractoemission produces EV's, it could explain both the excess energy and transmutation anomalies associated with the cold fusion experiments. In the cold fusion experiments, palladium or nickel is electrochemically loaded with hydrogen or deuterium to the point of saturation via electrolysis of water containing lithium hydroxide (or various salts). Best results are obtained by using a pure crystalline hydride. For a skilled electrochemist it only takes a few hours to completely load the hydride, but the heat anomaly typically manifests only after days of DC and pulsed electrical excitation.[29] After a time, the hydride begins to form cracks and then the anomalies are observed. If the cracking produces fractoemission EV's, and these couple to the ZPE, then both the excess heat and the lattice element transmutation can be explained.

Shoulders[30] demonstrates the EV transmutation phenomena by a trivial experiment: Just fire a single spark from a small Tesla coil onto a pure aluminum plate. With X-ray micrographic analysis determine what elements are formed in the crater where the spark struck. In his studies Shoulders has shown that EV strikes produce transmutation of the anode metal. The predominantly negatively charged EV accelerates toward a nucleus in the anode lattice. It also carries with it some residual ions which would smash into the nucleus like ions launched from a particle accelerator. Moreover, if the residual ions circulate around the EV vortex ring, the ring's symmetry would tend to aim its center (hole) straight at the nucleus, and the ions circulating through the center would be aimed directly at the nucleus with further force. Many cold fusion researchers have observed the transmutation anomaly. Patterson's[31] beads consisting of electroplated layers of nickel and palladium could perhaps be the most reliable and repeatable of the cold fusion, light water experiments. Here fractoemission seems to readily and quickly occur, yielding both the heat anomaly as well as transmutation. Unfortunately the cracking could also tend to make the beads flake and eventually wear out. Nonetheless, Patterson's beads make available the means for anyone to successfully replicate the transmutation and excess heat anomalies in a light water, cold fusion type experiment.

It would be ideal if a means could be discovered to induce fractoemission EV's, trap them within the material rather than dissipate them as heat, and then tap their energy directly via electromagnetic coupling. The invention of the late Floyd Sweet[32] might be just that discovery. Sweet specially conditioned two 6 x 4 x 1/2 inch ceramic blocks of barium ferrite such that the magnetic field of each would easily vibrate in response to a weak AC signal from nearby air core, electromagnetic "excitor" coils (Figure 5). This behavior itself appears anomalous since barium ferrite is a permanent magnetic material, and its magnetic domains do not easily shift. A bifilar pickup coil (the wire consists of two twisted, insulated strands) sandwiched between the ceramic blocks would pickup an anomalously large output signal in response to the stimulated magnetic vibrations. Moreover, the induced current flow in the bifilar pick-up was in opposite directions on the two strands. Perhaps this is the strangest of the observa-

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tions since it rules out standard magnetic induction. In addition, the output current was observed to be "cold" where many amps could be conducted into a load through thin wires without heating them. Some of the output signal was fed back to the excitor coils to make the device self-running. This feedback had to be done carefully for if the ceramic blocks were over driven, they would crumble into powder or dangerously explode. Sweet's invention is spectacular because from such apparent simplicity arises incredible behavior, including excessive energy.

How can the invention be explained? Sweet was secretive regarding the conditioning process, but recent information from other researchers[33] combined with the fractoemission hypothesis might allow its rediscovery. The first clue is the easy magnetic field shifting exhibited by the ceramic blocks. Since barium ferrite's magnetic domains do not readily move, it was proposed[34] that microscopic grains within the ceramic were cracked free by the conditioning process to allow them to easily pivot, and that such motion would produce and stimulate fractoemission EV plasmoids. If the plasmoids are produced around the peripheral region of the block, and if each energetically couples with its neighbor, then it is possible to induce an energetic vacuum polarization (or perhaps torsion field[35-37]) vortex in each block such that the top block contains a circulation opposite to that in the bottom block. Alternatively each single block could support a dual circulation since Sweet did have early successful embodiments that used only one ceramic block. Counter rotation is a principle for inducing any type of coherent pair production from the vacuum energy whether it be virtual elementary particles or macroscopic torsion fields. QED shows the principle arises from conservation of angular momentum. It is the counter rotating vortices that induce the energy onto the bifilar pickup coil bidirectionally, and its strands are guiding vacuum polarization currents instead of standard electron conduction. The last point might explain why the output wires remain cold. Sweet's invention exhibits so much new phenomena associated with the zero-point energy that its rediscovery would accelerate science into a new paradigm. Furthermore, its apparent simplicity makes it the ideal candidate for a repeating experiment that can be done even at home.

Conditioning Barium Ferrite

The goal is to create many charge clusters via fractoemission while trapping them within the material, and then to extract any excess power they might produce via a bifilar pickup coil. If we can induce a resonant, energetic circulation inside the material from an orderly alignment and mutual coupling of charge clusters located around the ceramic's periphery, a pair of macroscopic ZPE vortices might be created. The conditioning process is designed to make freely moving grains within the ceramic. As the grains rock back and forth in phase with a weak AC magnetic field from the nearby excitor coils, they create and stimulate fractoemission plasmoids in the microscopic cracks between the movable grains and the stationary portion of the ceramic body. Since Sweet attempted many variations of coil sizes and positioning in his experiments (most of which produced some degree of success), the exact parameters are unclear. The coil descriptions reflect the range as described by researchers close to the project. The conditioning steps are as follow:

1. Freeze the material. This will cause it to readily crack. Ideally a home freezer would be sufficient. If not, pack the ceramic block in dry ice. If it still fails to crack, dip it in liquid nitrogen, but be careful: It should be cold enough to create microscopic cracks, but not so cold as to shatter the entire ceramic.

2. Sandwich the block between two metal plates charged as a parallel plate capacitor at a high DC potential (20 KV) to induce interior corona (Figure 6). It should remain here during the steps that follow.

3. Stimulate the block with 60 Hz bucking magnetic fields from a bifilar coil around its perimeter (240 to 400 windings, 20 gauge, 1 to 2 amps). The coil can be the same one used for receiving the output when the device is running. Sweet claimed that the frequency of this conditioning signal would determine the natural resonant frequency of the self-running device. It will be interesting to investigate why this "scalar" excitation is necessary. (In some embodiments two smaller diameter, bifilar coils were placed on the face of the ceramic block instead of perimeter windings).

4. Abruptly pulse the block with a huge magnetic pulse from a standard wound, perimeter coil (220 windings, 14 gauge) by discharge from a large capacitor (6500 microfarads, 450 volts). The ideal timing would be at the peak of the 60 Hz signal driving the bifilar coil. (Be careful here, an electric shock could be lethal.) If the barium ferrite block is already a permanent magnet (with one face north, the other south), then the magnetic pulse should be of opposite polarity. The pulse will flip the domains at the ceramic's periphery nearest the coil windings. If the abrupt pulse fails to loosen any grains, turn the block over and repeat the conditioning.

The last step is intended to create many microscopic cracks near the ceramic's periphery to yield freely moving grains. Clearly some trial and error is required to get the con-

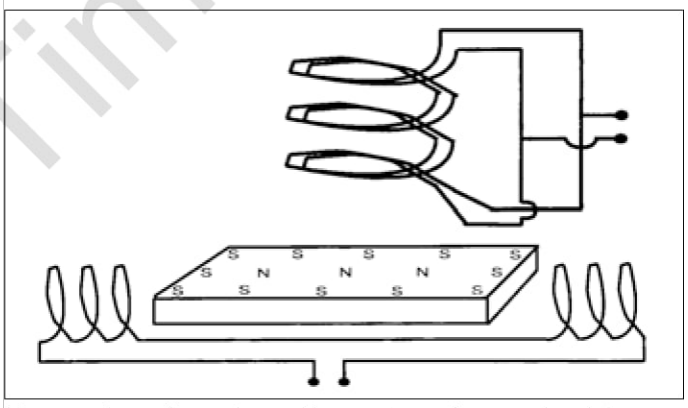

Figure 5. Sweet's conditioned barium ferrite has peripheral domains aligned opposite to those inside. Excitor coils on the side vibrate grains to induce oppositely flowing currents on bifilar pickup coil from internal fractoemission plasma activity.

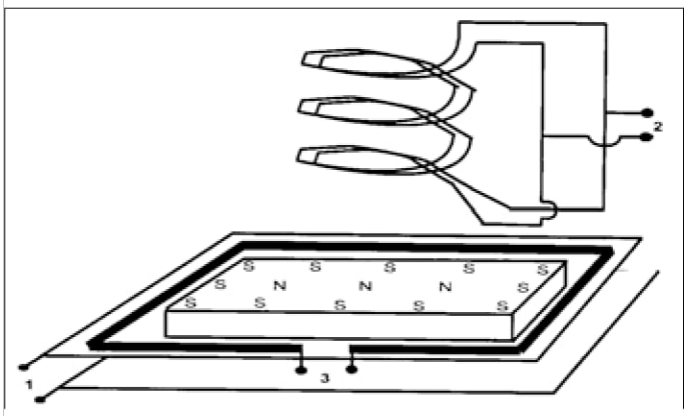

Figure 6. Conditioning barium ferrite with three excitations: 1) DC on the parallel plates above and below the ceramic block, 2) scalar AC on the bifilar coil with currents in opposition, and 3) huge pulse on the perimeter coil from a capacitor discharge.

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ditioning right. If the ceramic cracks too much, it could crumble, or the cracks would be too wide to support fractoemission. If not cracked enough, there could be no grain motion at all. The following suggestions will help the investigation of proper conditioning:

1. Work with small symmetric pieces at first. Many blocks could easily crumble or crack too much during the trials to find the proper stimulation that makes only microscopic cracks.

2. If grains are moving easily, the moving magnetic field can be readily observed with magnetic "green paper," a commercial plastic film designed to image magnetic fields. The image should easily move like a large magnetic bubble in response to a weak stimulating magnetic field from a small, hand held magnet brought nearby. An unconditioned ceramic would not manifest such motion since the domains of a permanent magnet do not easily shift. This comparison would be an indication of success; an unconditioned ceramic can act as a control sample for the experiment.

3. If a permanent barium ferrite magnet is used where one face is north and the other south, the magnetic field on the surface should be as uniform as possible to get the best results. Before conditioning a block, Sweet would carefully measure and map the magnetic field on its surface, hoping for a deviation of less than 5%. A uniform block will condition symmetrically and thus is more likely able to support the peripheral energy circulation.

4. A surprising energetic activity should be observable on an oscilloscope from a pickup coil placed directly above the material. Fractoemission plasma is known to persist for hours. A freshly conditioned ceramic could manifest electrical activity even in the absence of grain motion. When grain motion occurs an anomalously large pickup would then be observed. This would constitute confirmation of the fractoemission hypothesis.

If the fractoemission hypothesis is correct, it opens the possibility for a host of other experiments using other materials. Barium ferrite was selected because it is a dielectric, and can thus trap the fractoemission plasma. Typically magnetic materials are conductive and thus they would dissipate any charge clusters produced. However, other permanent magnetic materials might work as long as they are electrical insulators and could be successfully conditioned to have moving grains. Generalizing further, any dielectric material (not necessarily magnetic) could be used as long as the grain motion that stimulates the fractoemission plasma can be controlled (*e.g.* an electret or piezoelectric material where an external electric field controls the grain motion, or even a neutral ceramic where sonic means are used to synchronize grain motion). Of course, in each case the trick would be to properly crack the material into having freely movable grains that induce fractoemission. Confirming the fractoemission hypothesis sets the stage for discovery of a wide range of solid state devices that could tap the zero-point energy.

Summary

The empirical studies of Shoulders and Correa have brought zero-point energy research to a new plateau where the hypothesis of charge cluster EV formation could be the key for successfully creating zero-point energy machines. By examining many energy inventions with this hypothesis in mind, a pattern arises for techniques to extract the EV energy. Most inventions rectify the EV pulses as they decay. Some mechanically react to an explosive event from abrupt transitions from matter to plasma that likely form EV plasmoids. Some extract the heat the EV's produce when they decay. Possibly the most efficient means might be to trap the EV's in a material and couple to them. Fractoemission might be a means to produce and trap the EV plasmoids, and the invention of Sweet might qualify as the most elegant embodiment of a free energy device in the history of the field.

Sweet's discovery has the potential to become a paradigm shifting experiment because its apparent simplicity could allow widespread replication. It all depends on rediscovering the barium ferrite conditioning process. If it becomes easy to create freely moving grains in even small pieces of the ceramic, and if such grain motion does produce some energetic activity, then it is only a matter of engineering to increase the effect to where an appreciable self-running demonstration can be invented again. Once the fractoemission EV hypothesis is experimentally confirmed, other means can be engineered to create reliable and robust energy machines.

Perhaps most importantly, the discovery of a paradigm shifting experiment will require a team effort, for the experiment must replicate widely to have a lasting impact, and this will require willing cooperation among researchers to help each other succeed. It is our harmonious participation that will manifest a zero-point energy experiment capable of transforming the planet.

Acknowledgments

The author wishes to thank Walt Rosenthal and Don Watson for informative discussions.

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King continues on page 70

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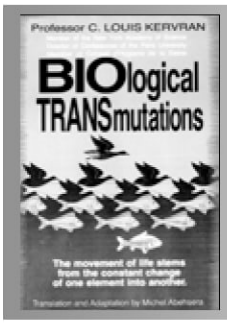
Book Reviews



Biological Transmutations

by C. Louis Kervran
ISBN 0-916508-47-1
$18.50 Paperback, 163 pp.
Happiness Press, 1980
Reprinted 1998
Review by Eugene Mallove

Reading this translation and compilation of a number of Prof. Louis Kervran's pre-1970 works is very disturbing, producing the disorientation that accompanies a possible deep paradigm shift in science. Kervran (1901-1983), a medical scientist and engineer with a high official position in the French research and occupational health community, had a life-long interest in the possibility of biological transmutations. His curiosity apparently began in his youth when he watched the hens pecking at specks of mica in the farmyard. His later professional observations concerned (in one small part) the anomalous re-appearance of robust calcium-bearing eggshells in calcium-deprived chickens that had been administered dietary mica (a potassium-rich mineral). Over a century earlier (in 1799), French chemist Louis Nicolas Vauquelin had noted this. The Kervran bio-transmutation story and its background is summarized eloquently in "Alchemists in the Garden," a chapter of the best-selling book *The Secret Life of Plants* by Peter Tompkins and the late Christopher Bird.

If Kervran's thesis is true, how could mainstream researchers, through the era of sophisticated modern biochemistry and molecular biology, have missed the omnipresence of biological nuclear transmutation? The critics' answer is simple: biological transmutation is delusion or fabrication—just as cold fusion remains, from their perspective. Post-1989 cold fusion critics, in fact, used the Kervran story to mock Fleischmann and Pons by linking them with a man they said believed in "nuclear powered chickens." But for those who seriously examine the evidence for inorganic, low-energy nuclear reactions and heavy element transmutation on electrodes in cold fusion experiments, there is sufficient reason to take Kervran's hypothesis seriously. If non-biological low-energy nuclear reactions (LENR) exist in the laboratory, why not in the natural world?

Indeed, with the backdrop of the cold fusion/LENR experience of the past eleven years, Kervran's work acquires far more significance. It may well turn out that cold fusion studies, pregnant as they are with revolutionary science and technology, may be but a late-blossoming appendage to a much greater truth about what Mother Nature herself has developed. This possibility may offend some cold fusion investigators, who perhaps fancy that they "got there first." We know how uncomfortable some cold fusion researchers are with the copious evidence for heavy element transmutation in modern experiments. Eventually it may be recognized that pioneers, such as Prof. Kervran, were on the low-energy nuclear reaction pathway long before the Utah announcement.

Kervran's thesis is that the transmutation of elements, in particular by reactions among the first few dozen of the periodic table, occurs regularly in biological systems—both in microbes and in multicellular organisms such as human beings. Transmutation is inherent to biology. He concluded that hydrogen and oxygen nuclei primarily, by adding or subtracting from other nuclei, is the essence of transmutation in biology. Some examples: ${}_{11}Na + {}_{8}O \rightarrow {}_{19}K$; ${}_{19}K + {}_{1}H \rightarrow {}_{20}Ca$; ${}_{20}Ca - {}_{1}H \rightarrow {}_{19}K$; or ${}_{12}Mg + {}_{8}O \rightarrow {}_{20}Ca$. Carbon might also participate, *e.g.* ${}_{14}Si + {}_{6}C \rightarrow {}_{20}Ca$. Kervran did not suggest how such exothermic and endothermic bio-nuclear reactions might be facilitated at the nuclear-atomic level (others would do that later[1]), but he did collect and correlate many anomalous biochemical observations from nineteenth and twentieth century researchers. He claimed these supported his conclusions, but he also made original observations and conducted his own experiments. If Kervran's thesis is correct, the natural world may teem with countless bio-alchemical factories, which, in turn, work profound alterations in the mineralogical composition of the planet. Geophysics Prof. M. Camberfort wrote to Kervran in 1974, "I have spoken of your work in my most recent book, because I consider that your hypotheses, largely confirmed in certain cases, are the only ones susceptible of explaining a number of facts noted by geologists, so far explained (in geological circles) by fairy tales and old wives' tales." Astronomer Carl Sagan, on the other hand, wrote to Kervran in 1962: "The types of reactions which you are proposing are quite impossible in ordinary chemistry. . .I would strongly suggest that you read an elementary textbook in nuclear physics." Sagan died in 1996, never having come to terms with cold fusion or Kervran.

In papers and books from 1959 through 1983, Kervran synthesized his biotransmutation ideas. Notable among his books, all published by Librarie Maloine in France, are: *Biological Transmutations* (1962), *Proofs in Geology and Physics of Weak Energy Transmutations* (1973), *Proofs in Biology of Weak Energy Transmutation* (1975), and *Biological Transmutations and Modern Physics* (1983). For the softbound English edition under review, translator Michel Abehsera compiled and adapted an apparently small but representative portion of Kervran's work prior to 1970. In his Foreword, Abehsera describes a meeting with Kervran: ". . . he showed himself such a dragon in science that nothing but science was discussed. . .he knew his subject well; he seemed to have read all the scientific books and articles published all over the world, to know the work of every living scientist. And when I told him that he had given to science a new direction and hope, he answered, his face growing red, 'I simply pointed out what has always existed.'"

During his lifetime Kervran received support for his work from several mainstream scientists who conducted biotransmutation experiments. Prominent among these was Prof. Pierre Baranger, chief of the Laboratory for Organic Chemistry at the École Polytechnique in Paris. Prof. Baranger in the late 1950s repeated the seed growth experiments of von Herzeele (conducted and published from 1876 to 1883), in which elements appeared to be *produced* in seeds sprouted in distilled water alone (based on analysis of the ashed seeds and plants). Von Herzeele had found that phosphorus went to sulfur, calcium to phosphorus, magnesium

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into calcium, etc.—many of the findings that Kervran would later ratify. Baranger reported his work in January 1958 at a prestigious scientific institute in Switzerland. In an interview with the magazine *Science et Vie* in 1959,[2] he said:

> My results look impossible, but there they are. I have taken every precaution. I have repeated the experiments many times. I have made thousands of analyses for years. I have had the results verified by third parties who did not know what I was about. I have used several different methods. I changed my experimenters. But there is no way out; we have to submit to the evidence: plants know the old secret of the alchemists. Every day under our very gaze they are transmuting elements. . .I have been teaching chemistry at the École Polytechnique for twenty years, and believe me, the laboratory which I direct is no den of false science. But I have never confused respect for science with the taboos imposed by intellectual conformism. For me, any meticulously performed experiment is a homage to science even if it shocks our ingrained habits. Von Herzeele's experiments were too few to be absolutely convincing. But their results inspired me to control them with all the precaution possible in a modern lab and to repeat them enough times so that they would be statistically irrefutable. That's what I've done.

No matter how solid the experimental evidence, biological transmutation, like cold fusion and inorganic low-energy transmutation, flies in the face of a paradigm that began at the very foundation of chemistry in the late eighteenth century: elements retain their identities—they do not change into other elements. Antoine Laurent Lavoisier (1743-1794), widely considered to be the "father of chemistry" or even the "Newton of chemistry," according to Isaac Asimov,[3] is responsible for that paradigm. We may regard this as a brilliant insight that was perhaps necessary to help make sense of the bewildering facts that emerged from centuries of alchemical experimentation. Moreover, the paradigm is ordinarily true, but the problem with the dogma launched by Lavoisier (ironically at the very time his contemporary Vauquelin was questioning the origin of calcium in chicken egg shells!) is that it has been too powerful, too rigid, and too enduring.

Lavoisier's scientific career ended on May 8, 1794, when he was guillotined during the French Revolution for having ties to "tax farmers."[3] His paradigm of element immutability survived the discovery of radioactivity in 1896 and the host of other conventionally accepted nuclear reactions. Unfortunately, it has grown so strong over two centuries that resistance to cold fusion, low-energy nuclear reactions, and especially biological transmutation remains intense. However, prior to the explosion of biochemical knowledge in the mid to late twentieth century at least one significant voice was raised in support of greater circumspection. Louis de Broglie, one of the luminaries of modern quantum mechanics is quoted by Kervran: "It is premature to reduce the vital process to the quite insufficiently developed conceptions of nineteenth and even twentieth century physics and chemistry."

Perhaps it is time to return to the wisdom of de Broglie. Kervran's work may have been a beginning in that direction. This book, though limited in scope and in places lacking the detail that is surely available in Kervran's original material, is a very useful introduction and overview of Kervran's ideas and the field of biological transmutation. This area seems destined to grow, especially with the recent founding of a formal society for the study of bio-transmutation, according to the announcement by French cold fusion researcher Dr. Jean-Paul Biberian.[4] Experimenters from France to Japan are now hard at work on this exciting new frontier. Others have already published contemporary scientific works.[5,6,7] We occasionally even hear rumors that certain biotechnology companies may be working in this area!

Though this book includes a six-page bibliography, and footnotes do provide many additional references to the scientific literature, it is disappointing that not all scientific studies referred to by name are adequately referenced. That is a small price to pay for the vista that this book opens on a possible new reality that may have been within us and around us for so long. The potential implications for science, technology, agriculture, and medicine are so large, the work of Kervran and of those who came before him demands great attention and the most thorough investigation.

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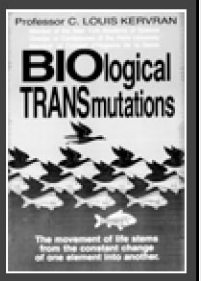

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A Renaissance Man Writes About Engineering: The Essays of Samuel Florman

Blaming Technology (1981)
The Existential Pleasures of Engineering (1994)
The Introspective Engineer (1997)
Review by Jed Rothwell

Time, *The New Yorker,* and *The Wall Street Journal* do not often review a book about engineering. When they do, you do not expect to have them call it "witty," "enchanting," or "sublime"—unless, of course, the book is written by Samuel Florman. Florman is a civil engineer. He writes about engineering as it relates to society, ethics, nature, innovation, happiness, and the limits of technology. His essays about these subjects are the best I have read. What Arthur Clarke did for science in *Profiles of the Future*, Florman does for the history and present concerns of engineering. Clarke has broad vision of how things may turn out for better or much worse. Florman understands the present, and he explains it in rich detail.

In general, Florman supports the status quo and he is an optimist, but he is far from blind to the shortcomings of technology. Much of this book is devoted to a gentle rebuttal of the 1960s anti-technology philosophies embraced by Lewis Mumford, Charles Reich, and E.F. Schumacher. Florman presents all points of view accurately, by quoting authors at length. He writes about a broad range of subjects: the history of engineering, product safety, industrial standards, risky research and development, job satisfaction, social alienation, recruiting women into engineering, and many unrelated topics such as ancient and modern literature, music, philosophy, and cats. He draws examples from history, literature, grand opera, Tom Lehrer songs, and rock music. I can hardly do justice to this rich mix of ideas in a short essay. Let me describe one of Florman's recurring themes which I think people in the cold fusion field fail to appreciate. Society chooses technology. No development is inevitable. We are in charge; when things go wrong it is our fault:

> Our contemporary problem is distressingly obvious. We have too many people wanting too many things. This is not caused by technology; it is a consequence of the type of creature that man is. . .
>
> It is common knowledge that millions of underprivileged families want adequate food and housing. What is less commonly remarked is that after they have adequate food and housing they will want to be served at a fine restaurant and to have a weekend cottage by the sea. People want tickets to the Philharmonic and vacation trips abroad . . . The illiterate want to learn how to read. Then they want education, and then more education, and then they want their sons and daughters to become doctors and lawyers. . .

Florman sees nothing wrong with people wanting "all that life has to offer," and he thinks that most people have sensible and moderate desires. The problem is that there are so many people and not enough good things to go around.

Problems like pollution or automobile accidents require a technological fix combined with legislation, moral suasion, and perhaps a change of heart. We can improve morally as we become more comfortable. Some people, *and perhaps society as a whole,* become philanthropic, spending more to ensure that other people's children are vaccinated and educated. Most people do not mind paying a little extra rent to cover the expense of construction safety regulations. We are willing to put aside vices when we find harmless ways to gratify the desires which gave rise to them. People give up slavery when machines do the work instead. They will stop polluting when electric or cold fusion automobiles cost about as much as gasoline powered vehicles.

People often talk about technology as if it had a will of its own, the way business news reporters speak of "Wall Street." "Wall Street is excited," as if it were a metamind beyond anyone's control: an entity greater than the sum of intellects and instincts of individual stockbrokers and investors. The sight of land being chewed up by ugly urban sprawl gives one the sinking feeling that "technology" is an unstoppable force of nature, like the kudzu vines in Georgia that overwhelm fields and forest, strangling and pulling down trees, like something out of a bad science fiction movie. Yet the endless ugly fast food restaurants and wasted space result from the deliberate actions taken by developers, bankers, bulldozer operators, legislators, and customers. We could build cities as beautiful, livable, and compact as Washington DC, or Toledo, Spain. Economic imperatives do not forbid attractive fast food joints. Not surprisingly, there is a McDonald's restaurant in the middle of an ancient square in Toledo, but it is installed in one of the old buildings, with a tasteful sign outside, so it does not clash or ruin the view. A little imagination, a few changes to the zoning laws, and few extra pennies per hamburger will fix the problem—but first, people have to decide there is a problem. After all, some people enjoy the architecture of suburban sprawl. Others ignore it, or assume it is the cost of progress, the way our grandparents assumed that billowing smoke from factory chimneys was unavoidable, or good news because "smoke means jobs," as people used to say.

Society changes, our expectations change, and things which are considered acceptable in one era are banished in the next. In the 1950s it used to be accepted that for every million dollars spent on a construction project, one worker would die in an accident. Even taking into account inflation, the death rate in construction sites is much lower today. Work sites are cleaner, better organized. Workplace safety laws are much stricter. This extra margin of safety costs money: extra equipment, extra time and materials, more inspections to shore up excavations and prevent cave-ins. Society decided that it is worth spending the money to protect the lives of construction workers. We improved morally because we have extra money.

We should not be sanguine about the future and the daunting problems we face, but history should give us hope. Engineers can solve most problems when society as a whole decides it is time to act. Engineers have the social responsibility to point out that potential solutions exist, but it is not up to them alone to implement solutions. Politicians, policy makers, and citizens must decide to spend the money and redirect social attention and energy. Florman writes:

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> Sir Hugh E.C. Beaver, addressing the First International Congress on Air Pollution in 1955, traced the seven-hundred-year-long campaign against air pollution in England. Complaint after complaint, committee after committee, report after report—all were ineffectual, as the centuries passed, and conditions grew progressively worse. Finally the London Smog of 1952, with its horrendous 4,000 deaths, set the scene for a new investigating committee, which was chaired by Sir Hugh. The committee's report was well received, said Beaver, and led to effective action, not because the report was exceptional in any way, but because the public was, at long last, receptive. The lesson to be learned, according to Beaver, is that "on public opinion, and on it alone, finally rests the issue."

This is how the world works. Engineers and scientists are not in charge of technology. They never have been, and they should not be blamed for its faults. The public is in charge, whether it knows it or not. Pollution, urban sprawl, the threat of global warming, recycling, water allocation, job losses caused by mechanization, and other problems can only be fixed by the public at large, in a political process. Although new technology is essential, there are seldom painless "fixes" that let us avoid tough decisions, expense, and social trade-offs. Even cold fusion will come at a high cost in unemployment and dislocation.

A related theme is that new inventions are fragile. Anti-technologists imagine that Madison Avenue beguiles us and big corporations dupe us into buying anything they come up with. Florman (and I) see the opposite: companies are slaves to the whims of the public, and they frequently stumble. Motorola, Kyocera, and other leading corporations recently spent $5 billion on the Iridium low orbit satellite communications network. They hoped it would attract millions of customers, but only 55,000 showed up. The venture is bankrupt and they must devote another $50 million to bring the satellites down from orbit and crash them into the Earth safely. As Florman says, "[New] technologies seem anything but the implacable force they are often assumed to be. On the contrary, they seem frail and vulnerable, like performers waiting anxiously in a theatrical agent's anteroom." I asked Florman what he thought of cold fusion. He said he wishes it well, but he thinks there is little chance it will pan out. In *Blaming Technology*, he wrote:

> So many wondrous inventions, materials, products—entire technologies—that were the center of attention just a few years ago seem to have dropped from sight. . .

I enjoy collecting stories about mismarketing and corporate collapse caused by smart people doing dumb things. Florman shares this morbid taste, which serves a purpose beyond enjoyable gossip about other people's woes:

> Recalling failed technologies would be no trivial pastime if it served to show how wrong is the widespread notion that technology conquers all.
>
> . . . [these technologies] mesmerized us all, launched on a flood of press releases, advertising, and go-go financial speculation, seeming to create their own markets and even to evoke appetites that had not existed before.
>
> It may be thought anachronistic to label as failures those brilliantly creative engineering achievements which happen to become commercial disasters, particularly when many of them are likely to reappear sometime in the future. But, when industry has gone all out to nourish a product-spending millions, risking reputation, and rousing the public with the vaunted forces of American salesmanship—only to give up and acknowledge defeat, then it is reasonable to say that the product has failed.

Florman lists thought provoking examples:

Rotary engines. Ford spent $10 million. General Motors paid a $50 million licensing fee and between $250 million and $300 million on development costs, yet it never sold a single rotary engine vehicle.

Fluidics, a kind of mechanical analog computer, which was featured in *Life* magazine.

The Xerox LDX (for long-distance xerography), or fax machine as we now call it. This was a commercial failure in 1981, although it later succeeded.

Florman made a list of failures he thought were "likely to reappear as successes":

Titanium alloys. These have been used for some time for things like eyeglass frames. More widespread, large scale use was predicted.

Hovercraft, or ground-effect machines. There are only two hovercraft large enough to carry vehicles. They sail (or fly) between Dover to Calais. They were built in 1968, and may be retired soon.

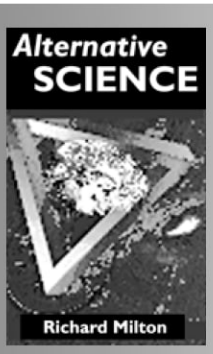
Factory-built housing. This is popular in Japan, although uncommon in the U.S.

Automated mass transit systems.

Super-conductivity. The book was written before the discovery of high temperature superconductors. Twelve years after their discovery there are no widespread uses for them, despite many predictions.

Weather modification

Florman comments, "so many disappointments, and so much money lost by so many smart people." These failures are reassuring in a way, because they prove that customers are in charge—the public decides. If cold fusion ever succeeds, it will be because the public demands it.



Alternative Science: Challenging the Myths of the Scientific Establishment

by Richard Milton
ISBN 0-89281-631-7
$14.95 Paperback, 264 pp.
Park Street Press, 1996
Review by Jon Norris*

Richard Milton's work, *Alternative Science: Challenging the Myths of the Scientific Establishment*, is an invigorating and revealing read. This book is an investigation into the mechanism of science. It examines the history of science, the nature of scientific method, the structure of the

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scientific establishment, and focuses on the increasing failure of the current system to deliver on its promises. Several areas are explored in detail, from cold fusion to the paranormal, and an appalling lack of honesty and integrity in the scientific establishment is revealed. The complicity of the media and government is also explored.

Milton opens with a short foray into some historical examples of the refusal of the scientific establishment to accept new ideas. He outlines the difficulties of the Wright brothers and some of the history of science's treatment of meteorites and X-rays. He examines scientific research in genetics, evolution, the paranormal, alternative medicine, and cold fusion. He describes battles fought by researchers and illuminates the barriers to innovative ideas and research encountered all too frequently. He lists certain areas of research which are strictly taboo. He shows just how vehemently those taboos are enforced by the scientific establishment, as well as how the power of the media and governing bodies of science are used to discredit the work and destroy the careers of those who dare to transgress.

His reporting on the analysis of military failures and what that research tells us about the scientific community is outstanding, especially considering the influence which the military exercises over scientific research these days. The "scientific fundamentalism" he exposes has much in common with the rigid authoritarian stance responsible for major military errors. The cause of this behavior is examined in some detail, and is found to result from the inability of authoritarian types in control to handle the cognitive dissonance of radically new ideas and data. Milton exposes the extreme measures the scientific power structure will take in order to preserve the status quo, and the power that certain groups and individuals wield. It is an eye-opening experience for any taxpayer to see the duplicity and fraud that are perpetrated on an unsuspecting public by government funded or sanctioned scientific institutions.

Milton has a penetrating and thorough understanding of modern science, due in part no doubt to his engineering background. It is enlightening to watch him unravel the errors and deceptions in the construction of the scientific establishment. He is not, however, anti-science. Quite the contrary, he holds very tightly to the ideal of scientific method and the integrity of rational investigation of our world.

His work is more accessible than Kuhn or Feyerabend, but is just as powerful in opening one's thoughts to the importance of understanding the context of current scientific research. It is a good read and anyone interested in science, particularly frontier science, owes it to him/herself to spend some time with this book.

*Jon Norris will be reviewing books periodically for *Infinite Energy*. He is a twenty-seven year veteran of the telecommunications industry. Mr. Norris began his study of anomalous data and fringe science in the late 1960s after exposure to John Campbell's editorials in *Analog*. He currently runs the audiovisual department of a small university and continues to comb the fringes of science for valuable information.

In the Wake of Sea Serpents

by Bernard Heuvelmans
Hill and Wang, 1968
Out of Print
Review by Mike Carrell

Published in the U.S. in 1968, Heuvelmans' analysis of 587 reports of great sea animals from 1639 to 1966 is thorough and fascinating. It is a scholarly, readable work, the first chapter addressed "To the Incredulous Reader" to orient the novice for the stories that follow. Its concluding chapter, "Disentangled and Classified at Last," is reminiscent of the ending of a good mystery novel, when all the parties are gathered in the parlor and the detective lays bare the complex affairs. Nine species emerge from the confusion, each supported by numerous sightings.

Dr. Heuvelmans at the time of writing the book was an associate of the Royal Institute of Natural Science in Belgium, a fellow of the Zoological Society of London, and a member of the International Institute of Sociology of Rome. He traveled widely throughout the world, taking photos of what remained of wildlife and trying to substantiate all local rumors and legends about animals still unknown to science. *Sea Serpents* follows a previous work, *On the Track of Unknown Animals*.

In the last few decades, the notoriety of sea serpents has faded in favor of UFOs or the Loch Ness Monster. It is easy to dismiss sightings as accounts of ignorant seamen of an earlier, superstitious age. Yet, Clyde Roper, the Smithsonian's squid expert, has spent the last four years trying to find a giant squid, and is still in search. Why the apparent scarcity in recent times?

In earlier times, sailing ships were quiet on the waters, following somewhat dispersed paths as driven by the wind. Modern powered ships are noisy, advertising their presence for tens of miles, and many creatures may go elsewhere. Only a tiny fraction of the world's oceans have been explored with any intensity. Many species are in decline for various reasons, including the impact of man on the ecosystem.

The existence of very large sea animals gained credence from beachings of very large squid. Unfortunately these were usually cut up for bait before scientists could get to them, so the size could only be inferred from fragments.

The 570 pages of text are filled with detailed accounts, verbatim quotations from witnesses, sketches, and careful drawings where available. The bibliography occupies thirty-five pages. A chronological listing of sightings is given. The accounts vary, of course, and Heuvelmans groups the features seen into nine species, as follows: 12 Long Necked (48 sightings); 22 Merehorse (37 sightings); 32 Many Humped (33 sightings); 42 Many Finned (20 sightings); 52 Super Otter (13 sightings); 62 Super Eel (12 sightings); 72 Marine Saurian (4 sightings); 82 Father-of-all-turtles (4 sightings) and 92 Yellow Belly (3 sightings).

These do not total the 587 listed, but are the most reliable of those studied. Heuvelmans does a very good job of bringing order to what is necessarily a collection of anecdotal accounts. The great whales with which we are familiar are apparently not the greatest of the sea animals. As recently as 1924 a portion of a squid was found in Natal. Comparing

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the available segments to other giant squid led to an estimated length of 115 feet, not including the long tentacles. This brief review does not do justice to the detailed reasoning that is evident throughout Huevelmans' most interesting book.

Sidewinder: Creative Missile Development at China Lake

by Ron Westrum
ISBN 1-55750-951-4
$32.95 Hardcover, 331 pp.
Naval Institute Press, 1999
Review by Thomas E. Phipps, Jr.

Tinkerers, gadgeteers, inventors, and would-be technical innovators of the present era may not even know the name of their guiding genius and patron saint. It is Bill McLean, a CalTech physicist from whose garage in China Lake, site of the Navy's great laboratory in the California Mojave Desert, emerged in the mid-1950s many of the key bits of technology that made possible the Sidewinder air-to-air missile. Sidewinder was in all senses a first. It was not like other guided missiles, nor was it developed like the rest. Other missiles were prose; Sidewinder was engineering poetry. . .and poetry that worked. The reason it worked is a tale I had best leave for the author of this splendid book to tell.

And tell it he does, with the tongues of men, if not of angels. I never heard of the author, Ron Westrum, a professor of sociology and interdisciplinary technology at Eastern Michigan University, according to the dust jacket, but I feel that he has earned the gratitude not merely of the Navy's technical community but of all Americans—for recording something we need to know about ourselves: that there was a time, not so long ago as geology measures it, and a place on this very planet, where Americans not unlike ourselves could get it together and accomplish something—achieve a common technical goal—for the sheer love of the doing. . . not goaded by accountants' budget numerology nor baited by prospects of profit. There was a leader who inspired them to do it. . .and that was Bill McLean. Unlike the Service bureaucrats—the Dukes of Plaza Toro, who develop the prosy missiles by leading from behind—Bill led from the front. For every problem he was there with an idea; at every test he was out on the range and down on his knees analyzing the fragments. The story is an irresistible one, and fortunately Ron Westrum has been unable to resist it. Obviously it was bigger than he was, it caught him up, and he tells it beautifully. I believe that the tale of Bill McLean and his China Lake hobby shop ranks in importance with that of the Wright brothers and their bicycle shop. It's the kind of story we, as Americans, need to know—likewise our "leaders" in Washington—for it might cause us to despise ourselves less and our leaders more.

This brings me to a reflection about modern history. In a few cases I have been present when some small facet of history seemed to be in the making, and on such occasions I have always wondered: Where are the modern historians? Holed up in academic departments, hoping history will go away and leave them to die in peace? Perhaps so that they can be reincarnated as ancient historians? Well, I never got the answer to such questions, but can report that Ron Westrum redeems his kind in my eyes. There is no question where this particular modern historian has been: up on the fact-gathering front, in the direct line of fire. I knew McLean and many of the people mentioned in this book, as well as the situation, and am happy to report that Westrum has got it just right. He has a good ear—you might say absolute pitch—and has done his homework. He has caught a bit of the spirit of McLean and of China Lake, which transcends technology, in that it is also the spirit of ancient British law, expressed in the dictum "Let Right Be Done." If all history writing were like this it would be not only an education but a pleasure to read. Before I get carried away, let me say that Westrum is no Gibbon in the use of the English language. . . but he writes straightforwardly, without academic jargon, and he has Gibbon's drive to draw impartial lessons from history, the whole history (the greatness, the decline, and the fall), and not to rest until he can surmise what it means. As with all real history, if it is to be humanly useful—not a mere tabulation of soporific facts—that is an all-important benefaction.

The best gauge of Sidewinder's military effectiveness came from the reactions of this country's enemies; the Chinese, against whom it was used in the Formosa Straits, called it "a cruel weapon." Soviet analysts (who procured plans through the spy Wennerstrom) said of it, "The almost biological harmony of all the functional elements of the missile, the elegance and the powerful logic of all the aspects of the Sidewinder engineering were obvious and overwhelming." Although to U.S. Service bureaucrats it was "the missile that nobody wanted," it quickly became a world standard for infra-red air-to-air missilery. I remember Bill's telling me that the original design incorporated seven distinct original technical inventions or discoveries (all analog—nothing digital in those days). For example, the IR detector element was damped against instabilities by a small plastic disk resembling a fifty-cent piece. A channel near the rim held a slug of mercury. The device could be tested by tossing it into the air spinning any crazy way and it would always come down in a stable orientation. I believe that nobody to this day has succeeded in analyzing that thing theoretically. (In the modern physics literature such a phenomenon could not even be reported, since no experimental observations are publishable in first-line journals without full support of theory. Buoyed by promises of a Theory of Everything, editors are accustomed to behave as if they already had it—as if theory's ship had docked forever on its final voyage. Physics and physicists were not that way in the 1950s when Sidewinder was developed.)

It has been said many times that Sidewinder could not be developed today. One of the reasons is today's top-heavy dominance of theory and of the computer simulations that go with it. One of the proofs is that the Soviets have possessed an improved off-boresight version of Sidewinder for the last seventeen years—a weapon to which our sad-sack R&D system is promising a U.S. equivalent no earlier than the year 2003. From this you might infer that China Lake no longer fights on our side. That might be a slight exaggeration, but it is true that by the late 1960s, when McLean left China Lake, time—the grim fellow with the scythe—was thinning the ranks of the World War II veterans among the Navy's top brass. Consequently, the Navy's organizational memory was

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beginning to fade as to why their Service had ever acquired its own government laboratories in the first place. It seemed so much neater and simpler to copy the Air Force's established practice of farming out the military's technical thinking to the industrial contractor who provides the lowest bid, the fanciest promises, or the tastiest Martinis (and can offer top brass the prospect of suitable retirement jobs). That's the American way. Isn't it what free enterprise is about? China Lake, with its flaunting of Yankee ingenuity in a government lab, was an affront to the American way. Plainly, China Lake had to go.

The job was done through a typical bureaucratic maneuver: China Lake was a Bureau of Ordinance lab, wherein it still had an earned backlog of sympathy. So, the lab was transferred to the Bureau of Aeronautics, whose officers shared their Air Force brethren's thinking about the strategic role of contractor-bought Martinis in decision-making. Next, BuAer sent out its finest Admiral, one Freeman—may the name live in irony—who promptly destroyed the civilian-military partnership on which China Lake had always been founded and exerted the heavy hand of "military control." (Admiral Freeman, I gather, can be placed somewhere between General Groves and Godzilla on the military-civilian diplomacy scale.) That's all it took. From then on the Navy came into line with the Air Force and began to buy Air Force-type missiles with lousy performance but wonderful contractor orchestration, generous retirement security, great Martinis, and gorgeous cost overruns. The American way "prevailed"—a word that our Air Force (Martini-sodden, perhaps, but ever ready to bounce back up onto the barstool with a catchy PR phrase) is partial to. China Lake and a better way were a fading memory. . .save for this book. That's why for the past seventeen years the Soviets. . .etc. You can fill in the rest.

As a footnote, I should like to add the personal recollection that there was one golden moment in the early 1960s when China Lake, a Camelot gilded by Sidewinder's triumph, was graced by the visit of an Air Force general. His Service was rumored to be considering emulating China Lake's success, and visions danced through civilian heads of his whipping out his checkbook and announcing, "I'll have a dozen of those." But it never happened. On soberer consideration by the Air Force, the metaphorical Martinis won. And now, for many years, they have won (against tomato juice) aboard the Navy as well. Yet consider how foolish it was, in purely fiscal terms, that the Navy destroyed China Lake as a center of creativity. . .when it could have auctioned the place off, just as it was, to the Russians (bidding against the Chinese) with tangible profit for all: The Russians would have had their improved Sidewinder even sooner than they got it, and could have saved oodles on their spy budget. . .while BuAer would have acquired augmented dollar resources to finance more generous cost overruns on the inferior missiles they were dedicated to buying from contractors. Such are the illuminations of hindsight.

One thing not mentioned in the book is that McLean and most others at China Lake, when they saw that the complexion of the Navy's top officer cadre was changing and that the reason for the Navy's having its own laboratories was rapidly being forgotten, began to look for a fatter dog their flea could jump onto. Thinking of this kind had to be sub rosa, of course: BuOrd did not fancy disloyalty in its labs, although in the end it was BuOrd that, in surrendering China Lake to BuAer, practiced disloyalty. It was obvious to denizens of China Lake that the place was a unique national asset, and that it could very easily be reconceived as a national technical problem-solving center. But if the Services were monumentally stupid in their self-destructive handling of this national asset, the stupidity of the nation as a whole far transcended monumentality. At the top levels our nation's way of dealing with problems is to nurture them into crises and then (Air Force style) to throw money at contractors in exchange for promises to fix the crises–failing which, we send in the Marines. The universities and their Washington job shop, the Office of Naval Research (ONR), did not relish "research" competition from China Lake, the defense contractors did not relish "development" competition, and–if anyone had asked them–the Bureau of Standards, Los Alamos, Brookhaven, Argonne, etc., would not have relished competition on the national laboratory level.

Yet what a grand national asset was there thrown away. Nobody consulted the taxpayers who were financing all this jolly parochialism. As for Congress, forget it. . .they are "managers" insensitive to technical issues. Beyond a nose-count of votes at China Lake, no political weight attached to the place. So, there you are–no self-help or other-help was available to China Lake's leaders to save the place from the predictable consequences of its orientation slaunchwise athwart the American way. I recall one gallant but short-lived ploy, incident to the fatter-dog search, which deserves mention because it may interest the readers of this magazine. McLean in the early 1960s saw very clearly one of the environmental technical problems this country was bound to face: the need to reduce automobile pollution. His way when he saw a technical problem was not to make a fuss about it but to seek a solution. He formed a small team of fewer than a dozen members to consider the design of a less-polluting vehicle type. As with Sidewinder, he had it all roughed-out in his head before starting.

It was obvious that the family car of the future would have to be an electric hybrid type. It would have to contain a prime power source, which he tentatively envisioned as a turbine-alternator combination. The turbine would run at its optimum speed and thus would minimize pollution and fuel consumption. It would be activated mainly out in the country, on long trips. The rest of the time, in town where pollution relief was most urgent, batteries would provide the necessary current to electric motors. I do not believe he envisioned using a piston engine as the prime mover, as current Japanese hybrid designs do. He would have regarded that as reactionary engineering. He strongly resisted an all-electric design, for the reason that (even with today's improved batteries) such designs are foolish–they manifestly fail to meet "operational requirements." His was a sensitive intuition for all the design compromises that must simultaneously be made in arriving at a successful system. And he could back up his intuition with sound technical arguments. His thinking was always "advanced," but not in trendy or "visionary" ways. For many years, for instance, ONR and other government money-trees had been funding fuel cell research. . .but that was generally good for nothing but promises. He was not deceived by promises and did not consider fuel cells in his tentative system designs. Even today, after all this time and untold research

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Bring Back Patrons

Charles W. McCutchen*

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Originally appeared in *The Sciences*, November 1977.

Real science is in continuous, unpredictable change. . .When the uncertainty is weeded out of science, what is left is stagnation.

Until World War II basic science was paid for by universities, private fortunes, and a few companies. Any government support was indirect—state governments subsidized state universities, and through its tax laws the Federal government in effect subsidized charitable donations of many sorts. World War II started a flood of direct government support for research that trained many new scientists and went on expanding until now most of science lives directly on the government.

As long as the expansion continued, any problems caused by government support tended to be smothered by the flow of money. The expansion has now stopped, and scientists spend more and more of their time competing for support. Just as long lines form at filling stations when gasoline is in short supply, so the poorer the chances that a particular grant application will be funded, the more and longer are the applications that scientists write, and that other scientists have to review.

Scientists long for the money flood to return, but like an addict's next fix this would only put off the problem. Support cannot increase forever at a rate that will keep ahead of every scientist's expectations. Competition is inevitable. We can only hope to make it less wasteful and unpleasant.

The Research Gamble

Government support has encouraged a misunderstanding of what scientific research is. It is a group of gambles that occasionally succeed, usually in unexpected directions, and whose practical pay-off is seldom immediate. Collectively it is a sure winner, but the odds favoring success in any particular project are small. The various institutions that supported basic science under the old system did it less for anticipated profit than because they believed it was enlightening, something a community, or even a company, needed for the good of its mind, not its pocketbook, and whose long-term results would benefit mankind. They were patrons of science.

The old method worked. It advanced knowledge and did not cost much. It was not businesslike, but basic science can never be businesslike. For an individual commercial firm, success in research is so unlikely, and when it happens it is so randomly directed and slow-maturing that the company seldom profits by it. Industry knows this. What commercial advantage did Bell Telephone reap from Davisson and Germer's discovery of the wave nature of electrons? "Hungry" companies do nothing but applied research in their own laboratories on their own money.

Alas, the government is afraid to be seen gambling with the taxpayer's money, even if it wins handsomely in the end like the house at Monte Carlo. So it attempts to make basic science businesslike, something that industry itself would not try. The government does not spend money unless it knows in advance what it is buying. Most government support pays for specific projects that have been described in grant applications. Granting agencies may claim to buy research, not results: A grant is supposed to be different from a contract. But means shape ends. The whole businesslike arrangement, the grant application, review, award and payment, demands the turning out of a "product," which in practice is work whose value is assured because it is very similar to that of one's competitors. Even if scientists and administrators want to gamble at long odds for high stakes, the arrangements they enter into, the very papers they sign, force them to think small and sure. There is no dependence on good luck, and not much chance to exploit it if it happens. It upsets the system.

Though a change of course will likely be approved by a granting agency, it is dangerous for the scientist. If the new direction proves barren the agency will have got nothing for its money, neither a new discovery nor the work originally proposed. It is wiser to bootleg new ideas, to think non-grant thoughts on grant-supported time, or to do unapproved experiments with grant-bought apparatus. Scientists are torn between contractual honesty and their vocation to do science. I think the latter suffers most.

Real science is in continuous, unpredictable change. At any stage only enough data or precision is needed to show what is wrong with that stage, and to point the way to the next. Most of the work that grants pay for is irrelevant to this process. It fills the literature with ever more detailed accounts of what we already understand, instead of hints about what we do not. Business itself dreads uncertainty, and business methods are designed to eliminate it. When the uncertainty is weeded out of science, what is left is stagnation.

Personal Contact

As well as looking businesslike, direct public support of science must appear to be fair and free of personal influence. So the agencies have mechanical and supposedly objective procedures designed, inevitably, to evaluate the typical run of

The Public has more than an inkling that it is not getting its money's worth out of science. Bureaucrats who believe that present procedures uncover all the good ideas will blame the waste on supporting poor ones, and seek to tighten the selection procedures.

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projects. But scientific advances are atypical events. The only things that most have in common are the totally unpredictable chains of happenstances that led up to them, and the large role played by personalities and personal contact.

Consider what happened when Donald Glaser sought support to develop the bubble chamber, an apparatus for displaying high energy nuclear reactions. In *A Random Walk in Science* (Institute of Physics, 1973), Robert L. Weber quotes Glaser: "I was refused support by ONR, AEC, and NSF on the grounds mentioned by one agency that 'the work was too speculative to spend government funds for it,' and I was denied access to the Cosmotron on the same grounds. These were not painful experiences because the University of Michigan found $750 to support my research for a year which was all that I really needed for that first year."

Real science does not fit the procedures, and is often eliminated by the very process of applying for a grant.

Though the bubble chamber was to win the 1960 Nobel Prize in physics, it did not attract support on its own merits. Support came from people who knew Glaser. A partly developed idea and its inventor together form a package that a sponsor may bet on. The idea itself does not, unless it is complete enough that success is almost certain.

In place of useful personal contact the grant system offers only influences that are not supposed to exist, and peer review, which we pretend is impersonal. Peers are the applicant's competitors, even when he and they are fellow members of a cabal who exchange favors. They profit by his success in drawing money into their collective field, and by his failure to do revolutionary research that would lower their own ranking in the profession. It is in their interest to approve expensive, pedestrian proposals.

Peer review is attractive to granting agencies because it looks democratic, gets the job done, and shifts the responsibility, all points that recommended it to Pontius Pilate. The practice of hiding reviewers' identities makes the accountability for decisions vanish entirely. In these bad times the system mistreats reviewers by sending them ever more applications, few of which will be funded. Reviewing gets sketchier. No doubt many reviewers are conscientious and fair, but this is in spite of a system that offers unique temptations.

Even advances that granting agencies at first turn down receive grant support eventually, once their success has been demonstrated. This allows the agencies to see themselves as benefactors of research that in fact they tried to kill at its most vulnerable stage. The public has more than an inkling that it is not getting its money's worth out of science. Bureaucrats who believe that present procedures uncover all the good ideas will blame the waste on supporting poor ones, and seek to tighten the selection procedures. But demanding that projects be even more precisely defined in grant applications will only make matters worse. Real science does not fit the procedures, and is often eliminated by the very process of applying for a grant. Try to imagine Willard Gibbs' application, or Planck's, or Alexander Fleming's.

The Patron System

If the present system is so wrongly aimed that improving it will only cause more harm, the way to advance may be to go back to the patron system. I think that most public money for basic science should be given to university departments, foundations, and perhaps to non-profit corporations to support whomever they wish. A scientist could become a protege because he had a good idea for future research, a good record of past research, or because he impressed the department head as having great potential. Unlike anonymous referees, the patrons would shine in the reflected glory of their proteges, and have a powerful incentive to help rather than hinder them. Abuses would occur, as now, but they would be harder to hide, and there would be so many patrons that arbitrary or malicious treatment by one or two need not blight a scientist's career.

To weaken the grip of university and institutional politics, a small fraction of the government support should still be disbursed directly by project grants. If project support were only one of several forms of patronage, its managers might take pride in outguessing the other patrons and make it a liberating force instead of a stifling monopoly.

There might even be enough money to go around. Grant applicants fish for funds in a huge sea of money. A large reduction in the projected cost of an experiment has an uncertain effect on the applicant's chances, so why not ask for the latest and best apparatus? It is very different in a department with a visibly limited budget.

Support for very expensive projects would still have to be negotiated individually.

How institutional support would be divided among institutions is a political matter. Spending public money always is, and the result is often sensible. Support should start at a level equal to what each institution was previously getting, but should not remain frozen. Well-run institutions could grow at the expense of poor ones. Some should fade away and new ones be launched. The patrons would use their entrepreneurial skills. Competition at this level might be fierce, but it would not affect the working scientists much.

About the Author

Mr. McCutchen was previously with the Department of Health, Education and Welfare, Public Health Service, National Institutes of Health in Bethesda, Maryland.

He was the NIH physicist who wrote a letter, on behalf of Eugene Mallove, regarding his assessment of the MIT PFC experiment and interchanges with MIT, to MIT President Dr. Charles Vest, March 19, 1992. See *IE* No. 24, p. 114.

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Hyperpolarized Helium-3 Offers Rapid Lung Images

Susanna Contini Hennink

Reprinted with permission from *Biophotonics International,* March/ April 1999, p. 86.
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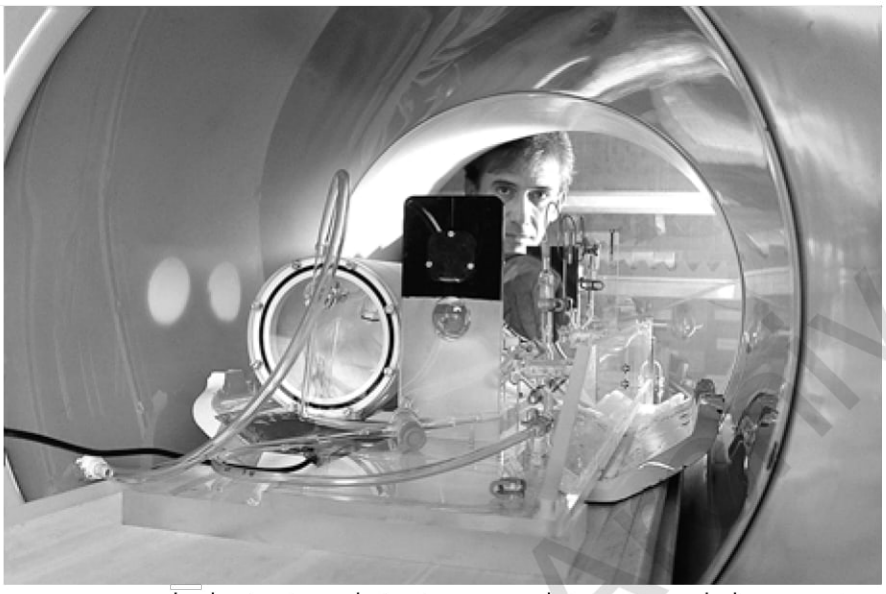
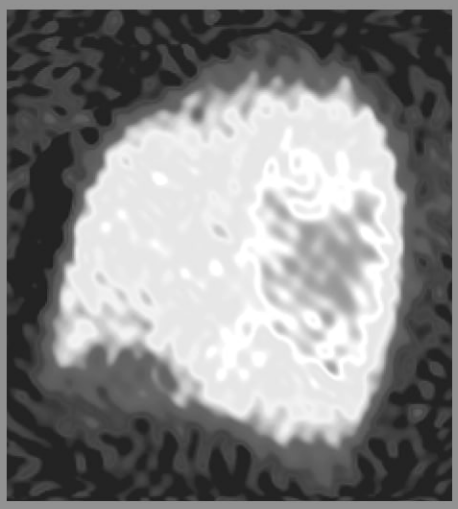
Editor's Note: We reprint the following intriguing article from Biophotonics International about the medical imaging uses of helium-3. This very rare helium isotope in the natural world is now being produced in some cold fusion experiments. We look toward the day when the low-energy generation and commercialization of such important isotopes for nuclear medicine is commonplace.—EFM

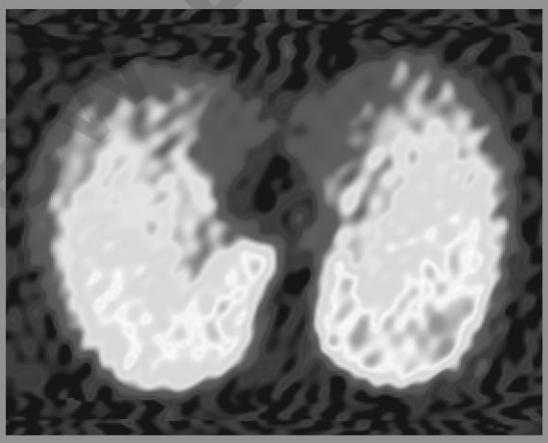


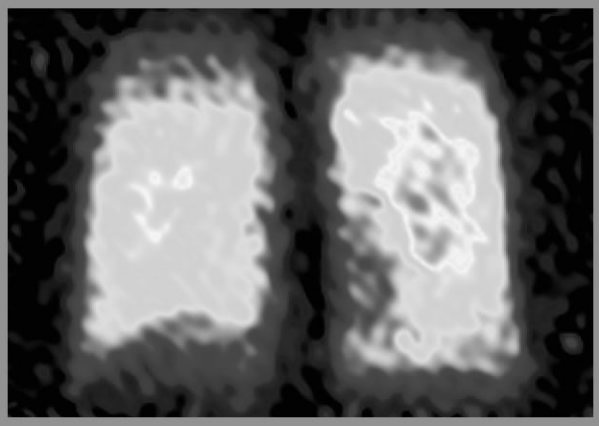
In the in situ polarization setup, low-pressure helium gas in a glass cell in the center of the imaging magnet is polarized by IR laser light, mixed to a neutral gas in a buffer volume, and inhaled through a clear tube.

Physicists at Centre Nationale de la Recherche's Laboratoire Kastler Brossel in Paris and l'Unite de Recherche en Resonance Magnetique Medicale in Orsay, France have developed a technique for imaging the lungs based on nuclear magnetic resonance (NMR). Helium-3 is polarized (highly magnetized) by an optical pumping method using a distributed Bragg reflector diode laser amplified in an erbium-doped silica fiber

These human lung images were obtained by hyperpolarized helium-3 MRI using a multispin echo technique. The 2-D projections display the gas distribution within the lungs of healthy volunteers. The first images were obtained at low field (0.1 tesla) in 1/3 s with 6 x 6-mm resolution. Work is in progress to achieve resolution on the order of 1 to 3 mm with comparable acquisition times. Thin slices, <1 cm, and 3-D images should also be attainable using a similar technique. These images were obtained with modest amounts of polarized helium-3. The gas is polarized (10%) by optical pumping, then mixed to a buffer gas just prior to inhalation.







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amplifier (IRE Polus) to improve its detection by magnetic resonance.

The polarization method, originally developed for low-temperature studies of highly polarized helium-3 fluids, is instead applied to low-pressure gas, after which the gas is compressed to reach normal pressure and is inhaled by the patient. Low-field magnetic resonance frequencies are used, allowing faster imaging sequences and lower-cost operation. Faster imaging also means that patients who have severe lung diseases and cannot hold their breath can be examined.

High-resolution tomographic images have been obtained using only a small quantity of polarized gas. Image quality is comparable to that of ventilation images obtained by scintigraphy in nuclear medicine. This technique, say the researchers, can lead to the development of lightweight magnetic resonance imaging (MRI) units, making rapid and patient-friendly lung examinations possible.

The subject lies inside the MRI unit and inhales a polarized gas mixture. An image of the gas distribution within the lungs can then be obtained.

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expenditures, when fuel cells are (still) supposed to be just around the corner, I wonder if they are more than perennial promises.

To give a measure of McLean's scope as an innovator, I mention that he saw a clean-sheet design of a hybrid car as a chance to explore radical concepts, for instance, of vehicle suspension. He envisioned the possibility of mounting the wheels independently, as in bicycle forks. This would fit with the option to design each wheel itself as the rotor of an electric motor–thus modularizing design, reducing system complexity, providing four-wheel drive, and enabling cars (by 90-degree fork rotation) to move sideways into tight parking places. Bill had a plenitude of ideas, but he didn't fall in love with ideas. If one failed, he junked it. He was a national asset in himself. He accomplished a lot. . .but much less than he might have done, if the nation had had the organizational flexibility and the vision to exploit his talents in the national, rather than the narrowly military, interest. We are all the poorer for that. And our children, and the military's children. . .

Once I remember Bill, almost plaintively, saying, "Y'know, you can do anything. . ." He was thinking about technology. But the thought was not expressed in his usual buoyant way. There was an unspoken corollary. The prepared mind needs to be favored not only by fortune but by the social system. The shades of night are falling fast.

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MERRY CHRISTMAS—AND OTHER HOLIDAY CHEERS TO ALL OUR READERS

—SOO SEDDON

Have you been good girls and boys this year? If so, you might be interested in tracking the white-bearded guy's progress from the North Pole with your Christmas goodies.

The NORAD Santa tracking website (www.noradsanta.org) will be up and running from Christmas Eve, bouncing a radar signal straight off the heavily laden sleigh onto computer screens around the world.

At the time of writing, all Santa systems are go and his workshop reports "toy production at full capacity and elves working overtime."

Apparently, just before reindeer are to report for installation of light-speed harnesses there will be a final review of sleigh stowage plans. All elves are to be available for the ISO 9000 audit next Wednesday, and Donner and Blitzen are desperately seeking a fawn-sitter for Christmas Eve.

NORAD is a little coy about the exact propulsion method used by the sleigh, although rocket motors are hinted at.

SLEIGH BELLS RING. . .

Santa could choose to pilot an HES (hybrid electric sleigh) for improved fuel economy and with regenerative braking capability he could minimize the energy loss from all those abrupt stops necessary when making house calls.

Also, emissions from an HES would be considerably more eco-friendly than those of traditional reindeer powered models.

SNOW IS GLISTENING. . .

Rocket power might be Santa's preference for high speed, long distance deliveries. He could check out the latest designs at ACME Rocket Sleds of Canyon Bottom, Arizona.

Company President, Mr Wylie Coyote, swears by the efficiency of his products (sales.acme@pob.cc).

A BEAUTIFUL SIGHT. . .

Animal rights protesters might object, but quadruped power would provide a useful back-up in the event of systems failure.

Siberian huskies would prove just as effective as reindeer. Dog-powered vehicles (DPVs) appear to be enjoying something of a revival and have encouraged the publication of evocatively titled periodicals like "Mushing Monthly"; savor it on-line at www.mushing.com.

WALKING IN A WINTER WONDERLAND. . .

Santa has, of course, been employing sleigh stealth technology (SST) to cloak his activities for years. A clearly visible gift-laden sleigh wouldn't stay laden for long. Perhaps he's even managed to utilize cold fusion power, which might explain why no one ever saw the crimson crusader filling up with 4-star (higher octane fuel) on his mega-trek around the globe.

I'm prepared to believe it, and so should you. Remember, every time a bitter and skeptical scientist states that there's no such thing as low-energy nuclear reactions, another of Santa's elves expires.

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Editorial continued from page 5

the frontiers of science are to be evaluated by voting, not by careful consideration of experiments and supporting theory? Raymo offered this predictable one-line summary: "Eventually, the scientific community arrived at a consensus: Cold fusion was a bust." This is not science. It is politics. We were also taken aback by a derogatory Raymo comment aimed at our efforts to examine how the process of science works in practice.

After initially agreeing over the phone to the general idea of allowing us roughly equal space to rebut Raymo in that same section, editor of Health and Science Douglas Bailey balked at publishing my draft rebuttal to Raymo. He referred me instead to the *Globe* Letters to the Editor Section, where significant truncation is likely to occur, if the reply is published it at all. We have brought this ethical matter to the attention of the National Association of Science Writers.

Events like these are part of the every day reality of the treatment of new energy in the news media. *Infinite Energy* readers may be surprised to learn that we have been blocked from advertising in certain magazines; *IE* Managing Editor Barbara Dello Russo may elaborate in a subsequent issue. For now, here are two instances:

(1) The prestigious scientific magazine *American Scientist* has refused to accept paid ads from us, whether for the magazine or for books, such as Dr. Mizuno's *Nuclear Transmutation: The Reality of Cold Fusion*, allegedly because "some of the readership would be offended." This is the publication of the Sigma Xi honorary scientific society, of which I have been a member since being elected in 1975.

(2) *Infinite Energy* ads have also been refused at *Science News*, a widely read weekly publication, in which we believed ads would have the best chance of helping to create new awareness about cold fusion. *Science News* has had no problem advertising the several books that attack cold fusion.

This is so brutally unfair, but so is life itself at times. As long as the flame of truth-seeking burns in peoples' hearts, there is hope that new energy will eventually topple the obtuse media that now reign virtually unchecked. When the tangible reality of new energy technologies finally emerges, as it will inevitably in the first decade of the Third Millennium, the media pack will turn 180-degrees and follow new leaders, many of whom may have been educated by us. We intend to help make that happen as soon as technically and humanly possible.

On a final note, "Happy 2001, Sir Arthur!"

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ried you'll steal our patent rights.'" We wish this were a joke, but it is not.

Park Recuperating After Accident

American Physical Society PR spokesman Prof. Robert Park (University of Maryland) was injured by a falling tree on September 3, 2000, while he was running in a local Maryland park. The accident caused bone fractures in both arms and one leg.

At present Dr. Park is recovering and will have to undergo physical rehabilitation, though he was for a brief time listed in critical condition due to an injury-related infection. Robert Park is the author of *Voodoo Science: From Foolishness to Fraud*, which criticizes cold fusion among other supposed "voodoo sciences."

Just prior to the accident, Park's last internet "What's New" column for the APS had noted the cold fusion memo to President Clinton written by *Infinite Energy* editor Dr. Eugene Mallove. This memo is now posted at www.infinite-energy.com. Now that Park is on the mend, we expect that he will continue his attacks on cold fusion, sans careful examination of the data.

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Device and Testing continued from page 42

thermometer through the polycarbonate plate; the thermometer bulb being placed in the solution, near to the inverted ceramic shaker. Three layers of aluminized bubble-wrap and 2-inches of fiberglass insulated the entire test vessel. A tiny clearance around the thermometer and inner electrode allowed steam to escape without soaking the insulation.

Visual testing in a clear glass beaker verified the lilac-pink arcing above 85 °C and above 155 VAC rms. Calorimetric testing in the stainless steel vessel at 208 VAC rms and solution temperatures around 95°C produced 88.5% and 88.2% output/input in two runs. Steam evolution carried away a significant amount of heat. Weight loss by the solution as steam (spattering problems were solved and no droplet entrainment occurred) adjusted the efficiencies to 104% and 101%, plus or minus 2% error. We think these results are not significant, and certainly are far from Mobberley's claim of 70% excess. We await Mobberley's comments before continuing this investigation. Mobberley has yet another way of performing such experiments, which employs a small water pump to suspend the arc at the tip of an underwater electrolyte jet.

Of Special Note

It may seem odd that this regular report in *Infinite Energy* is so relatively sparce. This may give the entirely misleading impression that NERL does not do a lot of work. The reason that so little is said is not that we do so little, but that we have many other projects which are proprietary (at least for now) or in preliminary stages. We are investigating claims by some inventors under non-disclosure agreements. We also have projects of our own for which we expect to apply for patents. In time, these obscure activities, should they come to fruition, will be made public. Of course, there are some false leads that are also on our table, and these you might not hear about, though as many readers realize, we do not shrink from publishing negative results. There are even inventors who show up, receive our assistance, then for a host of bizarre reasons leave the scene never to be heard from again. But please keep in mind that the new energy tree will bear fruit in due season. That is ever our goal.

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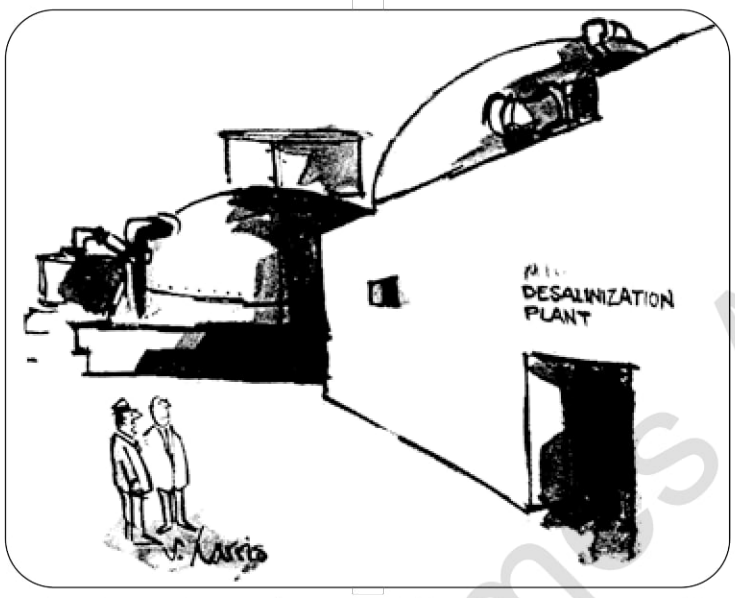
of very credible witnesses, like missionaries and world travelers of various degrees of wealth, all bringing reports of this creature of the jungles of Africa to "the West." The Loch Ness monster has been witnessed hundreds of times, once by a group of over 100 biologists on a conference outing, and they all agreed on what they saw, and issued a report, which got filed in the trash bin, because the "establishment" had decided that Nessie didn't exist. Slater is a psychiatrist, at Harvard (I think he has retired), but his interest is in the psychology of belief, to put it simply... and the fact is, most people are conformists; they will believe what the authorities of their time and place tell them is believable. It doesn't matter how many hundreds of credible witnesses there are for this or that, if the authorities don't buy into it, it doesn't exist for the 80% of the population that are really intellectual slaves. That may be a bit blunt, and maybe it is only 70%—I am always looking for evidence that the percentage is going down and there is some. The statistics on how many people now use "alternative" medicine of one sort or another—it's at least 50% of the population, and that means they are openly or secretly defying what is still the orthodoxy.



"Just in case it doesn't work, I'd like you to come up with some uses for 10 million gallons of salt water every day."

Printed with permission from Sidney Harris.

So, there's hope. Slater lists tactics used by the defenders of the orthodoxy to "get rid of" the pioneers. Ridicule is a favorite. "Scientific amnesia" is another—since each occurrence is an anomaly, and there is not theoretical context to put it in, it is treated as though it never occurred and that it has no history. Ridicule works hand in glove with amnesia. If you ridicule and humiliate a few witnesses, you will get far fewer reports in the future, and this will make your amnesia a lot easier to maintain. "Mythification" is another technique. You introduce a fantastic tone not present in the reports of witnesses. Someone reports seeing a large animal swim across a lake, you scoff at "these stories of monsters, coming out of lakes and carrying off screaming women." This technique is used on UFO reports a lot, and is almost invariably applied if the report comes from a non-white or non-western person. Of course, they are just talking mythology; they don't know any better. As Slater observes, ". . .by implying that these reports are hysterical, fantastic, and tied to folklore or legend, scientists manage to reserve their presumed monopoly on truth and correct observation, while debunking what they will later 'discover' on their own."

"Hoaxes" is another technique, closely related to mythification. Hoaxes are dramatic and even when a real hoax has been exposed, the story of it tends to be included in the data for that phenomenon, simply because the story of the hoax is more colorful. Reality tends to be a bit humdrum, the careful descriptions by honest witnesses hardly ever make exciting reading. Slater points out that the more blatant hoaxes usually occur just as large numbers of people are starting to take the phenomenon seriously. This has been true for the Loch Ness monster, Bigfoot, UFOs, and the Piltdown hoax. The Piltdown skull was the subject of over 500 learned treatises, scientists who saw through the deception were silenced and for forty years it was the centerpiece of evolutionary theory, and the hoax was not "uncovered" until far more compelling evidence had come to light. Even while the Piltdown skull was being elevated to the throne of sanctified evidence, the newly discovered paleolithic cave paintings were being rejected as hoaxes, one of the principal objections being that the figures depicted had such large genetalia. Slater has a good time with that one.

Another technique for keeping the altars of orthodoxy clear of anomalous "waywardness" is selecting and weighting the evidence. This technique is a favorite of "armchair skeptics." Slater gives the example of Philip Klass, the professional anti-UFO skeptic, who elevates selecting and weighting the evidence to the level of operating principle. "His first principle is that witnesses may be 'inaccurate' in trying to describe the phenomenon. His second principle is that some details will be 'reasonably accurate.' So then his job is to pick the report apart, decide which details are true and which are 'inaccurate' and offer an interpretation that allows us to dismiss the whole thing as really just ordinary reality ('swamp gas,' a 'weather balloon') or hoax."

Number six is "blunted questions." You have experienced this a lot. If the skeptic feels actually confronted by real evidence, he can still retreat by asking, "If what you say is true, why haven't there been any?" The question is spurious and comes from arrogance and ignorance, not knowledge.

Number seven is "theoretical disproof." This is the last-ditch stand of the skeptic and it is widely used. "Over-unity" is impossible, therefore you can't have built a device that gives you more heat than you put in. Your claim is disproved by theoretical bias, long before you produce a working model. You are familiar with this one; it is used all the time against "cold fusion." But all it does is display the prejudice of the skeptic. As Slater points out, the premise underlying all theoretical "disproofs" is that nothing unknown (to the skeptic) could possibly exist, therefore no matter how big the mountain of evidence gets from someone else's point of view, the skeptic can still just trot out the old bias and say the mountain doesn't exist. Anomalies must be gotten rid of, fast. That is why the ho-hum pragmatic device that heats homes is going to be so important. It will silence the skeptics very quickly.

Slater points out that all biases of science are really one bias—an aversion to anything that threatens the dominion of rational control and the power of the ego to define reality. Myths are particularly frightening because they create a reality that is not only different but richer, more compelling. Science is droning on, trying to be "objective" but there is a festival going on outside the lecture hall. Heads are turning, people in the back get up and leave, science has to fight to keep its audience; it's tough! No wonder they resort to ridicule, selective amnesia, mythification, blunted question, etc.

I have gone on at some length here. I wanted to give you some idea about the long history of prejudice, and some idea about how systematic the resistance to cold fusion is. How every major advance in science has been fought bitterly for decades before it was finally embraced. It's not the story told in school, because it doesn't flatter anybody. So much reality slips between the cracks of conventional thought, conventional education. You escaped, I escaped, I have a lot of friends that escaped; we are the 20% or 30%. The pollsters are not asking the right questions to measure this because most polls are designed to find out how people spend their money, not whether anyone thinks for themselves or not.

Slater talks about what motivates the orthodoxy-makers

New Energy Times Archive

and maintainers. He calls it the "Tinkertoy Style." Reality styles are what a culture teaches its young—what is important, what part of All-There-Is to pay attention to. So we have a Tinkertoy Style, which says it's real if I can take it apart and put it back together, it is made of parts that can be manipulated and rearranged. It is clearly a style based on a need for control, divide and conquer, reduce and dominate. Kuhn would have liked Slater. I don't think they ever met. Kuhn hung out mostly with philosophers. That is how I met him, since my husband was a philosopher of science (Wilfrid Sellars). I never had a chance to talk to Kuhn about cold fusion, but I suspect he would have kept an open mind. He was pretty savvy about premature closing of the mind. So was Wilfred. He wrote a little essay called "The Myth of the Given," arguing that the idea of what is "given" is always arbitrary. In mathematics that is understood, but in physics it is not. But there is no real difference, it's just that the physicist thinks there is a "given" that is "objective"—but it is still dependent on his terms, how he defines reality, what he learned in graduate school, what terms he uses to establish for himself what the "given" is, and therefore no less arbitrary or relative than the mathematicians. It is a subtle point and philosophers are still debating it, even while physicists just keep on doing physics and assuming all sorts of "givens" that are in fact merely assumptions.

The Tinkertoy Style still defines what's real, what's important, at least at the level of our public image of ourselves, today just as much as in 1977 when The Wayward Gate was published. But you know what, I think the whole things is coming unglued. There is a ferment at the grassroots level, out of the glare of the TV cameras, below the radar of the mass media, and it is going to redefine what's important. I can't see the future all that clearly; it seems like every day more variables pop up and more regularities get dismantled, and that's fine with me, because I believe that consciousness is what's real, not matter, not the physical body; consciousness goes with the soul, the soul creates the whole show, to learn about itself.

So we are going to leap over the bastions of orthodoxy and I hope the cold fusion guys are leaping with us. I think they are. And the new science and new energy people and the remote viewing people and the lucid dreaming people and the alternative health people. We are just going to leapfrog over them; we are already doing it and I'm glad you are with us. The new paradigm, the mother of all paradigms, is going to bring all these streams together to build the new age. I hope you don't have a reaction to the term new age because you are certainly part of it.

Susanna Felder
Florence, Montana

Editor's Response: . . .I am very happy that you renewed your subscription, despite the doubts that you encountered. We need all the subscribers we can get, since the subscription price and the paltry number of advertisers we have been able to attract certainly does not cover even the production costs of the magazine, not to mention all the other things we do from PR, lab work, trying to deal with political leaders (hah!), etc. Fortunately, we have a few benefactors who close the gap—we need more of them, so send them our way if you should meet a few potential ones!

I am very happy that despite your lack of intense scientific training you perceive that cold fusion/new energy "is the wave of the future" and that you "believe" in it. You have already run circles around your engineer brother who does not believe in "over-unity." Ask him whether Ben Franklin would have "believed" in a conventional fission nuclear plant after seeing that no wood or coal was going into it, and that only hot metal was causing the steam production.

Again, many, many thinks for your kindness and fine thoughts. You are a good spirit, I see. "Live Free or Die" . . . as we say in these parts!—EFM

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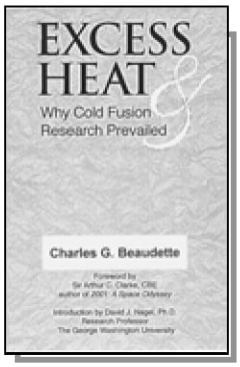

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